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WORLD PETROLEUM

VOLUME VI — **Editor, E. W. Mayo** — NUMBER 6

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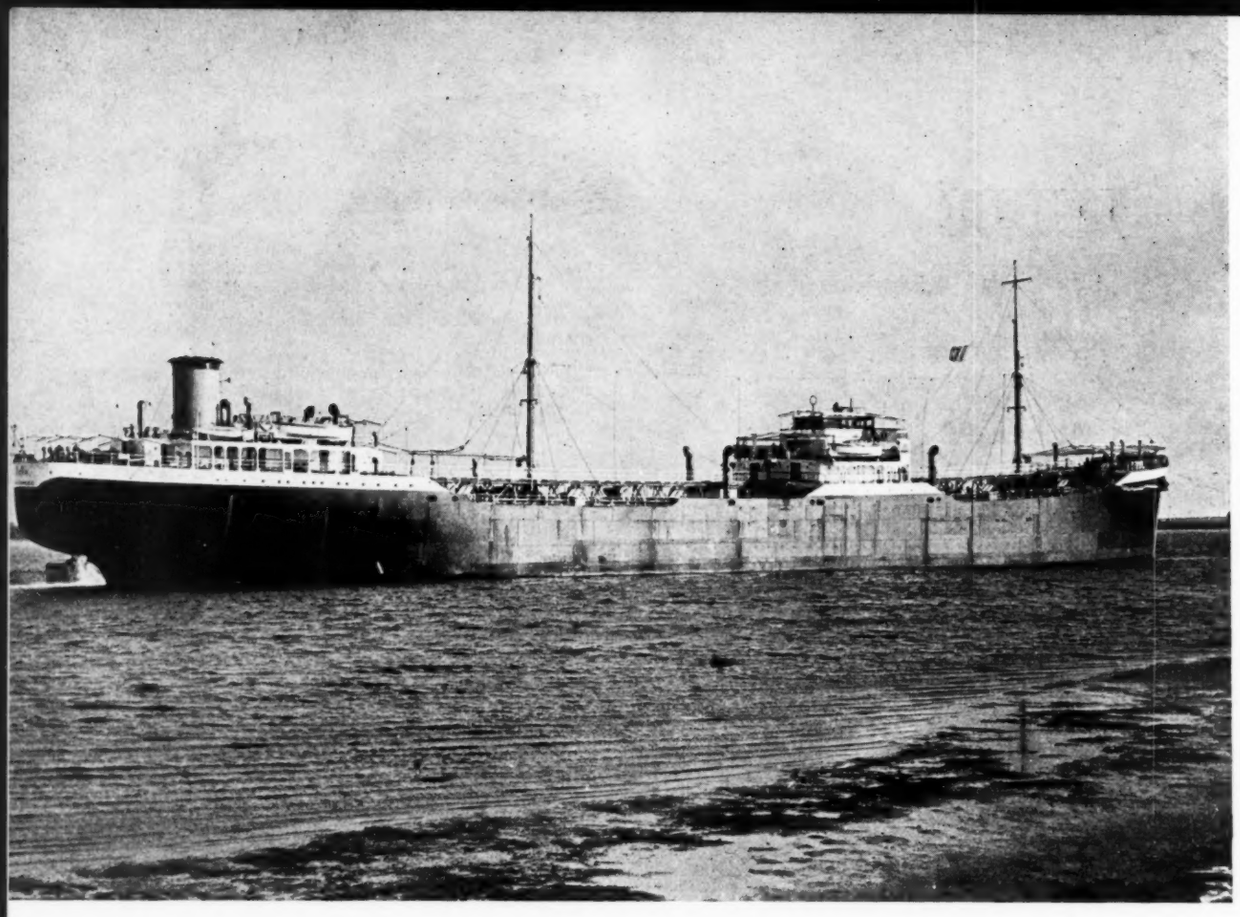

Perma, new tanker recently completed at the Odense yard in Denmark for the Anglo-Saxon Petroleum Co. Ltd.

Important links in the chain that extends from oil well to automobile gasoline tank—the tankers and terminals.

Port Autonome de Bordeaux. Vue aérienne du Bec d'Ambès et de ses installations pètrolières. Adroite la Dordogne; a gauche la Garonne.

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PETROLEUM

Corpus Delicti

SPEAKING in terms not to be misunderstood and with the unanimous voice of its nine members the Supreme Court of the United States has swept aside at one stroke the elaborate mechanism of federal control over industry set up by the National Industrial Recovery Act and has restored the Constitution of the United States to its historical position as the supreme governing instrument of the Union. While there will be protests from various quarters its action will be accepted by all and, we believe, will be welcomed by the majority of the American people.

Accepted willingly as an emergency measure the NIRA has grown in disfavor in proportion with the conviction that the emergency was passing. Efforts to continue its bureaucratic system of control as a permanent feature of the governmental system were viewed with increasing doubt and dissatisfaction except among those who wished to change the system itself or those who had become a part of the NRA machine. To many members of Congress and of the Administration, as well as in unofficial circles, the court's decision will come as a distinct relief.

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Code and Public

SO FAR as concerns petroleum, operation under the code should have taught the industry some valuable lessons which it may find means to apply in future while no longer being subjected to the curb on initiative and the constant interference with details of operation that have attended some phases of its operations during the past twenty months. Leading members of the industry have declared repeatedly that it is capable of solving its problems if left alone. They now have the responsibility of helping to prove the correctness of this claim. The decision of the Supreme Court should make it easier to bring about adoption of the proposal for regulation of production through an interstate compact and for a trial of the efficiency of that plan. If the industry is able to substitute cooperation for coercion it will justify its own position and will confound the advocates of strict centralized control.

In its own field WORLD PETROLEUM has endeavored to observe code requirements but never has felt that a business openly and honestly conducted should be subjected to the dictation of either a self-constituted or an officially created bureaucratic organization. For this reason we returned the official blue emblem when it was first sent to us and have declined to display it in our pages. Our position, we believe, has been fairly representative of that of the majority of American citizens who are not yet willing to admit that their effort at self government is a failure.

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Tanker Fleet Modernization

WITH a virtual moratorium in shipbuilding for the past five years as a result of the decline in maritime trade that accompanied the industrial depression the problem of obsolescence has become a serious one for many shipowners. This condition affects the world's tanker fleets as seriously as any other branch of the shipping industry. Fifty-five percent of all tanker tonnage is more than ten years old; thirty percent has been in commission for fifteen years or more and ten percent has exceeded twenty years in service.

In the opinion of many competent engineers the time is at hand when the modernization of numerous large tanker fleets is of economic advantage if not an actual necessity.

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Scrapping Needed Too

AT A TIME when there is still a large though lessening amount of surplus tonnage the building of new vessels may aggravate unfavorable operating conditions unless provision is made for eliminating those which have survived their economic usefulness. Various plans for international action to retire a volume of tonnage equal to new construction have been put forward but none has been adopted.

In this respect the bill now pending in the United States Congress for government aid to merchant shipping includes a wise provision. It calls for the appointment of a Maritime Authority which must give its approval to plans for new vessels before they can receive the benefit of subsidy. It provides further that the Authority may acquire vessels for which there is no commercial need and apply their purchase price toward the owner's share in the cost of new construction. These vessels may be laid up, scrapped or sold, but are not to be used in a service already adequately supplied. They cannot linger on the scene to disorganize the charter market and interfere with the profitable employment of better class ships. Some such plan for concurrent scrapping and building might well be adopted generally.

Standard of California's International Rôle

Expanding Activities of the Company in Numerous Directions Convince Observers of its Determination to Play a Larger Part in the World Situation.

ENLARGING the scope of its operations, seeking to establish itself in a position of greater security in the international field, Standard Oil Company of California has been engaged for the past three years in a program of expansion which will make it a factor to be reckoned with in world markets. Some of the projects involved were initiated earlier but from the time when the projected merger with Standard Oil Company (New Jersey) was abandoned the California company has been going forward quietly but energetically with a series of moves that are extending its operations far beyond the borders of the state from which it takes its name and in which it has long occupied a dominant position.

A conspicuous development that aroused much speculation in international trade circles was the action of the company in 1930 in obtaining a concession for exploiting the petroleum resources of Bahrein, a small island group in the Persian Gulf. During the past three years some 16 wells have been drilled in Bahrein and have proved the existence there of an important field producing crude that is said to be similar in its characteristics to the output of the Kirkuk field in Iraq developed by the Iraq Petroleum Company. Operations in Bahrein have been conducted along conservative lines and the wells have been produced to only a small part of their capacity which has been reported as in the neighborhood of 100,000 bbl. per month. Two wells are now being drilled and two rigs are going up.

Having advanced from the position of a holder of "potential reserves" to that of an actual producer in the Near East Standard of California was prepared to listen to proposals from other companies supplying European markets as to granting its output a share in this business. These others, according to report, showed little interest, being faced with the problem of handling the large amount of Iraq crude which began flowing through the desert pipe line to the Mediterranean in the latter part of 1934 and not anxious to encourage additional supplies from that quarter. The California company did not insist but pursued the even tenor of its way. It has limited its Bahrein output

K. R. Kingsbury, president, directing the expansion of Standard of California to an international oil company.

and has sold to Japan most of the cargoes shipped from that point from the beginning of 1935 to date.

Meanwhile, in 1933, another surprise was sprung in international oil circles when it was announced that Standard of California had obtained from Ibn Saud, Arabian king, a concession to an extensive strip of territory in eastern Saudi Arabia, thereby adding greatly to its possibilities as a Near Eastern producer. Exploration work has been going forward in this territory and while no announcement has been made regarding it geologists familiar with the region believe that rich deposits may be developed. Some months ago it was reported that Standard of California was extending its geological studies to Africa.

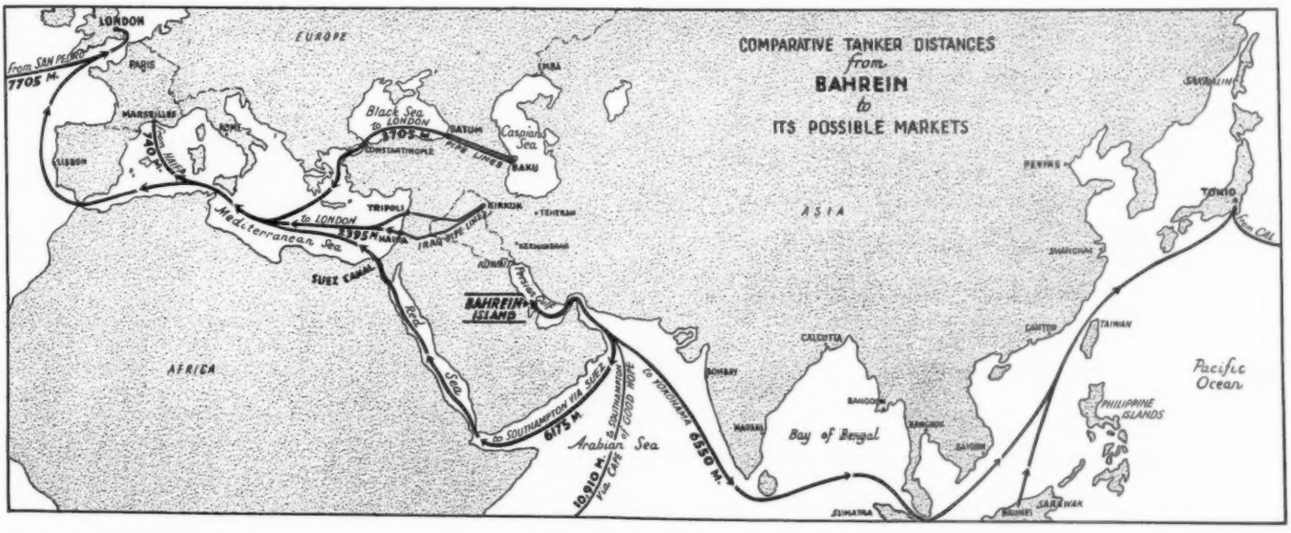
Location of California Standard's subsidiaries in the Persian Gulf presents certain handicaps for reaching Europe. Tankships must make the long voyage around southern Arabia and through the Suez Canal and there is always a possibility that canal tolls may be raised to a point that would make competition difficult. Against this may be set the fact that the cost of producing Bahrein crude is extremely low, some reports say not more than 23 cents per barrel. There is also the fact that in working this crude the proportion of low grade fuel oil, for which a market is not always readily available, is larger than in some others.

In another part of the world, however, Standard of California possesses a distinctly valuable asset from the viewpoint of European marketing. It is the largest owner and producer of Kettleman crude which possesses ideal qualities for European refiners. The thought may have occurred to those who shape Californian policy that by finding a market in the Far East for Bahrein's output, displacing some of the California crude that has been shipped there in the past, and sending high grade Kettleman crude to Europe through the Panama Canal the situation would be well served.

At any rate oil from Kettleman Hills has been moving to Europe, specifically to the Raffinerie du Nord at Dunkerque, France, and the Raffinerie de Berre, near Marseilles. Reports in circulation in France have it that the relation of Standard of California to these two refineries is not that of an ordinary contract supplier but that the California company has become the actual owner or at least the holder of a substantial financial interest in both.

In quarters usually well informed it is stated that no refinery deal has been concluded, leaving the implication that one is under consideration. A delegation of three Standard of California representatives headed by B. W. Latcher sailed from New York for Europe recently and it was reported at the time that the purpose was to examine various proposals involving the shipment of Kettleman crude.

Another rumor that has gained circulation in recent weeks is that negotiations or at least discussions have been under way looking to the possible acquisition of Russian Oil Products, the Soviet marketing organization in Great Britain, by the



California company. To all of these reports the only official answer vouchsafed from California Standard's headquarters in San Francisco is:

"We have a group of men looking over the situation in Europe but will not discuss the matter at this time."

It is not only in Europe that the California company is looking to a possible extension of its operations. Through its subsidiary, the Richmond Petroleum Company, it has taken a more active part in Mexico of late and its representatives have been "looking over the situation" all along the west coast of Central and South America. This activity moved the representative of a competing company to remark recently: "It is almost impossible to step ashore in any important port nowadays without finding a couple of representatives of Standard of California on the scene."

Acting to protect its market position in event of increased shipments of Kettleman crude, Standard of California recently completed a 21,000 bbl. per day combination plant at its Richmond refinery for handling heavy crudes from Kern County fields. It already has extensive cracking facilities at both Richmond and El Segundo refineries in California and at the present time is rebuilding furnaces in the former plant.

That careful planning preceded its entry into the European market in a more aggressive manner is seen in the recent completion of a pipe line from Kern County storage tank farms to Estero Bay. Standard already had an eight and a ten inch pipe line from Kettleman Hills to Estero Bay for transportation of Kettleman crude. The new twelve inch line is from Rio Bravo and Kern River where the company is credited with having 20,000,000 bbls. of heavy crude in storage. Most of this, however, is classed as "non-gasoline bearing crude" and has been transferred in its classification to "fuel oil" and is shipped as such.

Improved methods of cracking and the fact that these Kern County crudes contain a higher percentage of lighter fractions such as propane and butane for which there is a ready market, enable Standard to reduce its domestic requirements for Kettleman heavy crude and to "re-open the bid" for a part of European markets.

A well informed California oil man put the situation in plain words by saying, "Neither Bahrein crude with its bar sinister of possible increased canal tolls, nor ordinary California crude offers much to tender for a piece of the European 'pie' but when Standard puts itself in position to move into the game with tankers of Kettleman heavy crude it must be given a hearing."

Interested observers of these recent moves on the international checkerboard have satisfied themselves that Standard of California is executing a well defined policy of expansion and is preparing to claim a place among the seats of the mighty in the international arena. This is a perfectly honorable ambition but it may not recommend itself to others already occupying such positions among whom Standard of New Jersey and the Royal Dutch-Shell Group are most conspicuous examples. It is regarded as more than a possibility among those who have studied the situation that there may be a considerable intensification of the "friendly competition" which has been growing in recent years between the two Standard groups located on opposite sides of the American continent.

Refinerie de Petrole du Nord at Dunkerque which has been receiving California Standard's Kettleman crude and which is now said to be controlled by the California company.

Motorization or Domestic Production?

Germany, Wishing to Encourage Both Domestic Production of Gasoline and a More Extensive Ownership of Automobiles, May Find the Two Aims Mutually Exclusive.

THE MINERAL oil policy of the present German administration embraces several aims that are distinctly contradictory. While it is deemed advisable to increase the motorization of Germany to a point that will at least equal that of other leading industrial countries, the exigencies of foreign exchange require that a large part of German motor fuel requirements be met from domestic sources. Thus, while low priced motor fuel is essential to the encouragement of motorization, high prices for motor fuel are equally essential for the encouragement of domestic, and especially synthetic, motor fuel.

In addition to these factors, one must consider the revenue to the Reich represented by the duty on imported petroleum. During 1932 petroleum imports amounted to 2,478,085 tons while consumption totaled 2,655,000 tons; in 1933 consumption had increased to 2,915,000 tons of which 2,684,968 tons were imported, and in 1934, 3,602,000 tons were required for domestic consumption, of which 3,154,611 tons were imported.

The gasoline price situation may be said to offer the greatest present obstacle to a wider distribution of motor vehicles. While most of the gasoline used in Germany is imported, duties are designed principally to encourage the development of domestic production and synthesis. For example, the fact that world prices of motor fuel have been steadily declining has had little effect on internal German prices. Early in 1935 the price of American gasoline shipped free to Hamburg was approximately RM. 3.50 per 100 litres but the wholesale price for delivery in tank cars was RM. 25.80 and the price at the retail pump was RM. 34.— after payment of a duty of RM. 16.35 per 100 litres. Gulf prices in 1935 were only about 20 percent of their level in 1925 whereas the Hamburg pump station price had increased from 33 pfg. per litre in 1925 to 34 pfg. per litre in 1935.

These high prices have made possible increasing domestic production of gasoline which in April 1935 benefited by a further reduction in mineral oil tax from RM. 3.80 to RM. 1– per 100 kg., while imported gasoline is charged with a duty of RM. 17 per 100 kg. plus tare of 20 to 29 percent.

The connection between gasoline prices and density of automobile traffic is clearly shown by comparing the United States, where the gasoline price per U. S. gallon is 19.9 cents and the density of automobile ownership is 213 per 1,000 population, with England, where the gasoline price is 28.6 cents per U. S. gallon the density of automobile ownership is 33 per thousand, and Germany, where, with a price of 34.4 cents per gallon the density is only 11 per 1,000. In Italy with a price of 40.7 cents per U.S. gallon the concentration is only 7 per 1,000 population.

The high duty and other measures have at least succeeded in increasing the domestic production of gasoline. The first step in this direction was the stimulation of domestic crude production by uniform laws and government encouragement as well as by a considerable price incentive. As, however, domestic crude production could not be increased to a point where it would satisfy the entire demand, steps have been taken to encourage hydrogenation by the Bergius process (I. G. Farben) and by the Fischer gasoline synthesis of water gas and other gases. The difficulties presented by this method of production are to be found not in their technical aspects but rather in the economic features. Nevertheless, Braunkohlen A. G. has been organized as recently as the autumn of 1934 with a capital of RM. 100,000,000 for the manufacture of gasoline from brown coal and indicates the intensity with which domestic production of gasoline is being encouraged by the government despite the discouraging effect that resulting high prices are likely to have in the limitation of motorization.

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British Drilling Regulations Published

CONDITIONS under which permission may be obtained to prospect for and develop petroleum production in England were made public in May of this year.

At least ten important companies already have applied for permission to explore for oil in several locations in Great Britain and action by the Board of Trade on these applications has been delayed pending completion of the PETROLEUM (PRODUCTION) REGULATIONS, 1935.

An extremely rational system of regulation is contained in the Petroleum Production measure which should permit the orderly development of any pools uncovered in England. It expressly stipulates that the Board of Trade has the power to require unit operation of a pool when the Board shall deem such action in the public interest. Royalty payment on production will range between 3/– per ton and 6/– per ton for crude and between ⅛ d. per Imperial gallon and 2 d. per gallon for casinghead spirit. There is a minimum annual rent required but this may be applied against royalty. Provision is made for inspection of properties to enforce proper maintenance and to assure development according to the best oilfield practice with the least waste. Licenses are of two types: prospecting licenses, running for three years with possibility of renewal, cover not less than eight square miles nor more than 200 sq. mi.; and, mining licenses, running for 50 years with possibility of renewal, covering not less than four nor more than 100 sq. mi.

Turmoil Rules Washington Oil Situation

Court Decision Ends Code Control. Congress Unlikely to Pass Federal Control Measure. Many Measures Still Awaiting Action.

By Don J. Kirkley

WASHINGTON, MAY 29

TODAY a delegation of oil men meeting here in answer to a summons issued prior to this week's Supreme Court decision by Wirt Franklin of the Independent Petroleum Association was received at the White House. While of course not at liberty to quote the President the impression they received from their visit appears to be that while in sympathy with the objectives of the Thomas bill he is inclined to believe that as it stands it may be unconstitutional.

It seems fair to say that the President still believes some specific oil legislation desirable before the adjournment of Congress and that he is favorable to federal cooperation with the states through approval of an interstate compact and creation of a federal fact finding agency the states to remain in supreme authority inside their own borders. As to the delegation's recommendations for the prohibition of stock control through interlocking directorates and the segregation of integrated companies into separate corporations the President's attitude appears to be that these things may be desirable but constitute too big a problem to be tackled now.

What, if anything, can be done to salvage some part of the New Deal from the wreckage created by the Supreme Court's demolishment of the NRA on Monday is engaging the attention of all members of the Administration from the President down with none apparently anywhere near an answer. Preliminary conclusions indicate the following possibilities:

1. A new NRA, with considerably more latitude for industrial self-government and voluntary compliance, and distinct limitation to interstate commerce and such industries as directly affect it.
2. Separate legislation on hours and wages and perhaps on fair trade practices, the method for the former completely undecided, while the latter could be achieved by expanding the Federal Trade Commission and giving it broader powers.
3. Complete revision of the "security" program along lines as yet undefined, as well as revamping of the slight handful of emergency agencies left standing after the Court's barrage had swept aside virtually all the rest of the New Deal.

There is division of opinion as to whether the Supreme Court's action has helped or hurt the chances of oil legislation but impartial observers cling to the belief that if such legislation is passed it will eliminate practically all federal regimenting power and leave control to the states with federal cooperation in an interstate compact.

Proponents of the Thomas bill contend that the principle on which it rests has not been affected by the court decision and assert that they will redouble their efforts to bring about its passage.

Charles Fahy, chairman of the Petroleum Administrative Board, and an attorney, sums up briefly the attitude of those favoring the bill:

"The decision in no way affects the constitutional principles of the Thomas bill."

Jack Blalock of Marshall, Texas, also an attorney and field-leader of the group fighting the bill asserts for the other side:

"This decision very definitely shows that the federal regulation of the production of oil, a purely intrastate matter, is unconstitutional. It would be worse than folly to pass the Thomas bill. . . . It would simply mean building the future of the great oil industry on a foundation of sand. It certainly would be stricken down by the Supreme Court."

Other less outspoken advocates and opponents of the bill agree that sufficient doubt has been cast upon its constitutionality to merit closer study. One legal authority intimates that it might be upheld because of these lines in the opinion:

"Hence, decisions which deal with a stream of interstate commerce—where goods come to rest within a state temporarily and are later to go forward in interstate commerce—and with the regulations of transactions involved in that practical continuity of movement, are not applicable here."

Through telegrams which began coming into the Planning and Coordination Committee the day after the decision came down, the oil industry appears to have decided to sit tight until the atmosphere clears, with the majority of its members willing to abide voluntarily by the code provisions looking to the maintenance of balanced production and demand, present hours and wages and fair competitive tactics.

J. D. Collett, Chairman of the Planning and Coordination Committee, in advising all local, state and regional committees to cease code activities, further informed them that they should keep their organizations intact, explaining that this appeared desirable "until the industry gets its feet on the ground."

"It is certainly the sensible thing for the industry to hold the ground it has gained," Collett said, referring to the spreading move for voluntary compliance with the more important phases of the Code's operations, primarily crude and gasoline production, fair trade rules and hours.

Friend and foe alike agree that the decision did not affect the Connally hot oil law, which provides for regulating interstate shipments of oil and products in accordance with state regulations governing their production, but disagreed over whether that measure alone would be sufficient to prevent overproduction. The Connally law was passed after the Court last January held Section 9 (c) of the NIRA to be unconstitutional.

An upward trend in demand estimates, resulting in June being given the highest crude oil and gasoline allowables since the code came into effect, respectively 2,651,000 bbl. daily and 37,490,000 bbl., is expected to continue through July and August, according to federal statisticians who keep up with that subject. The demand is now in the 1931 range, with all indications pointing to the fall demand being considerably higher than the consumption in the fall of 1934.

Revision of the mineral leasing act will be accomplished before June closes. It has an important bearing on future development and applies in all states except Texas, where the United States government owns no land except that which may have been purchased for Army posts, buildings and the like. The proposed changes, as submitted by the Department of the Interior and introduced by Senator

O'Mahoney and Representative Greever of Wyoming, immediately met such a storm of protest that they were further revised by the House Public Lands Committee, with the Department's consent, before being reported.

The major points were changed, and the subjects now stand in the reported bill:

1. Applicants for leases in areas outside known producing structures shall, for 30 days, have a preferential right without competitive bidding, as opposed to the Department's original plan for requiring bids.
2. Royalties shall be 12.5 percent, with some opposition remaining to provisions which will permit, in cases, a 25 percent royalty. The bill originally would have permitted a 25 percent royalty in most instances.
3. Protection of existing equities, by extending existing permits to December 1, 1936, with permissive authority for the Secretary of the Interior to extend them an additional year if desired. The bill, as originally introduced, in effect would have cancelled the permits within a few weeks.

The tax question will come up for an airing shortly. It has been held up behind the fighting over the NIRA, the social security bill and other legislation requiring the attention of the House Ways and Means Committee, where revenue legislation must originate under American parliamentary procedure. Chairman Doughton hopes that hearings can be arranged early in June as the prevailing taxes expire June 30.

Action of Secretary Ickes in seeking to bar The Texas Company and Continental Oil Company from bidding on government orders because of alleged violation of labor provisions of the code apparently becomes ineffective with the abolition of the code by the Supreme Court thereby obviating the necessity for court action by the companies.

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A.P.I. Revolts Against Federal Control

Directors Outline Position in Petition to Congress —Mid-year Meeting at Tulsa Considers Suggestion of World Congress Session in U. S.—Technical Discussions.

MEETING in Chicago May 3 on special call 41 directors of the American Petroleum Institute adopted a definite platform of opposition to federal regulation of the petroleum industry beyond the steps necessary to give effect to conservation efforts of the states. Their statement, which was arrived at only after a full airing of divergent views, took the form of a petition to Congress which was subsequently published as an advertisement and is being extensively circulated in other ways. While opposition to governmental regulation of details of the oil business has been growing this is the first time that the Institute has undertaken an extensive campaign of propaganda to place its views before the public. Its chief recommendations are:

FIRST: That there should be a minimum of regulation by government, state or federal, to the end that private industry may be free to serve the public most efficiently and economically.

SECOND: That the state governments, having the power to regulate production of crude oil and natural gas to prevent waste and so conserve a valuable natural resource, should be encouraged in that effort.

THIRD: That the federal government having the power to deal with interstate and foreign commerce, and to authorize interstate compacts, should supplement the production control effort of the states: By making permanent and rigidly enforcing the Connally Law (S. 1190) prohibiting the shipment in interstate and foreign commerce of oil produced in violation of state laws; By approving the interstate compact which has already been ratified by the legislatures of five of the principal oil producing states; By directing the U. S. Bureau of Mines, a competent fact-finding agency, to ascertain the crude oil production necessary to meet the consumptive demand of the nation and to make its findings available to the interstate compact commission and the respective conservation authorities of the oil producing states; and by exercising control of imports to a proper ratio to domestic production for such a time as is necessary.

FOURTH: That as concerns marketing, the field of greatest competition, there is no reason to single out the oil industry for special federal intervention. That industrial pacts and agreements when voluntarily made by any industry for the purpose of eliminating unfair methods of competition should be permitted.

FIFTH: That any such economic straitjacket as is contained in S. 2445 or similar proposals for the enlargement of the N.I.R.A. would serve to increase the price of gasoline and demoralize the industry.

Coming directly after the action at Chicago the fifth mid-year meeting of the Institute held at Tulsa, Oklahoma, May 13 to 16, assumed a place of minor interest so far as concerned the general affairs of the industry. The Chicago declaration was the main unofficial topic of discussion among those in attendance. One matter considered on which no final decision was reached was the suggestion of the Institution of Petroleum Technologists in London that a World Congress be held in the United States in 1936 under sponsorship of the Institute in collaboration with other technical and sectional societies. There seemed to be a general feeling that it might be advisable to defer the Congress to 1937 in order to allow more time for preliminary arrangements.

It was decided in view of the importance of electricity in petroleum operations to appoint a permanent electrical committee which will make its first report at the annual meeting next November.

Numerous important technical papers were presented at the meeting which will be reviewed in the abstract section of WORLD PETROLEUM.

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B.O.D. Pipeline

PLANS for British Oil Development Company's pipeline to the Mediterranean from Iraq are now being studied, reports A.G.I.P. of Rome, controlling interest in Mosul Oilfields Ltd. B.O.D. is a subsidiary of Mosul Oilfields. A.G.I.P. is the Italian government controlled oil company of which Professor Umberto Puppini is president and Ing. Oreste Jacobini is technical director and vice president. A.G.I.P. announces a net profit of Lire 9,028,800 for 1934 and plans to enlarge its cracking capacity at the Disca plant near Venice.

M/S TOA MARU, 13,748 ton Diesel powered tanker, on trials during which she made 19.1 knots.

Tanker Construction Indicates Trends

A Review of Tanker Construction in the Recent Past Shows Definite Trends Toward Liner Building, Diesel Power with Waste Gas Auxiliary Power, Higher Speed.

By A. C. Hardy
B.Sc., F.R.G.S., A.M.I.N.A.

RENEWAL of tankship construction, after a long period of inactivity was signalized in mid-November 1933 by the placing of orders for a dozen 12,100 ton motorships of the ANCYLUS class by the Anglo-Saxon Petroleum Co. This mass order was distributed among various European shipyards and was followed in January 1934 by the letting of contracts for six ships for the associated Eagle Oil Company—their first motorships. Activity has continued more or less steadily ever since, although confined mainly to replacements in the regular liner fleets.

Tramp tanker construction has not picked up since the slump. The owners have combined, protectively and with reasonable success, in an international pool and those ships of tramp category now building or recently completed are reasonably sure of good charter employment, for at least one of the big oil companies likes to charter, for diplomatic no less than for practical reasons, as well as to build.

Two South American contracts followed the order for the six ships for the Eagle Oil Co. One of these was a small ship officially owned by the Compania Transportadores de Petrolifia of Buenos Aires. It was constructed by the Furness Shipbuilding Company of Haverton Hill on Tees, being built in record time, on the Isherwood system of construction and has steam driven triple expansion engines with Scotch boilers for propulsion, being similar in characteristics to vessels constructed for work on Lake Maracaibo. At about the same time an order was placed with the Deutsche Werft of Hamburg for a 10,000 ton ship with steam driven triple expansion engines and Scotch boilers for the Argentine government. This order had long been pending. Shipbuilders all over Europe had been negotiating for it and it is reported that currency difficulties delayed the actual placing of the contract. It is stated that this ship is something of a novelty in that she is fitted with luxury accommodation for forty passengers, thereby justifying the rather unusual title of a "passenger-oil tanker."

Two single screw motor tankers are now being built in Europe for Oriental Tankers Limited of Hong Kong, a company affiliated with Standard-Vacuum Oil Company. These are both 15,000 d.w.t. vessels and are practically sister ships except that one is constructed according to the Arcform developed by Sir Joseph Isherwood.

One of these two vessels, the M/S W. B. WALKER is being built at the yard of Fried Krupp Germaniawerft, Kiel-Gaarden, Germany. She was launched on April 9 with Mrs. W. B. Walker as sponsor and is to be delivered June 14 this year.

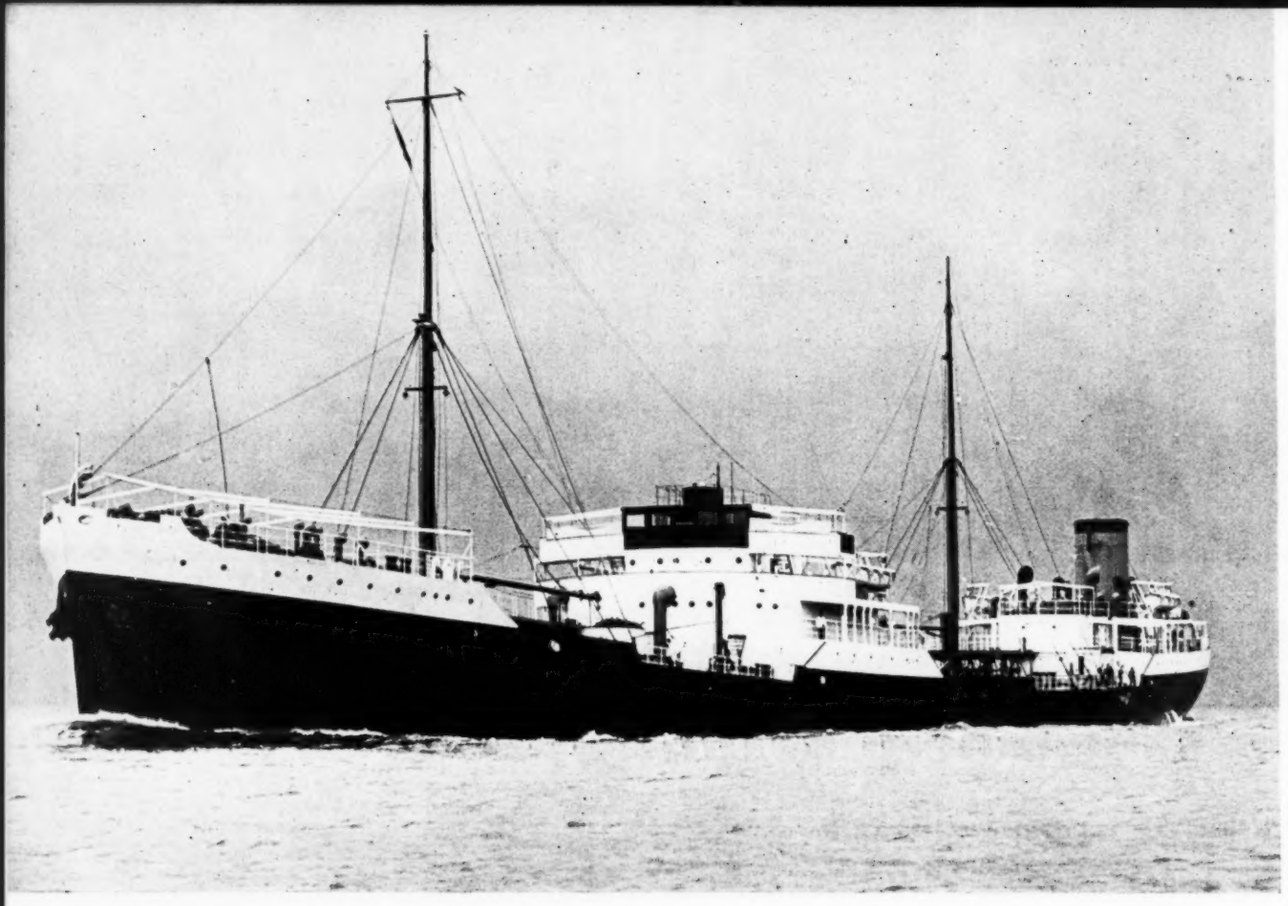
The second of these tankers, the M/S G. S. WALDEN is building at the Rotterdam Drydock Company's yards at Rotterdam, Holland. She will be launched June 15 with Mrs. G. S. Walden acting as sponsor and will be delivered August 14, 1935. This latter is the largest tanker ever built in Holland. On account of her Arcform her moulded breadth will be 73 ft., or 5 ft. greater than that of the M/S W. B. WALKER and she is expected to develop one-half knot better speed.

Otherwise, the principal particulars of these two tankers are identical.

W. B. Walker and G. S. Walden

Deadweight tonnage	15,000
Length B.P.	485 ft.
Moulded Breadth	68 ft.
Moulded Depth	37 ft.
Draft	29 ft. 6 in.
Displacement	21,125 tons
Designed Trial Speed	12½ knots

Krupp motors are being installed in these vessels. The main power unit is a single acting, 2 cycle, 6 cylinder, solid injection, heavy duty, marine Diesel engine capable of developing 3600 B.H.P. Diesel propulsion has been found particularly efficient and economical for the long voyages in which it is proposed these vessels will be engaged.



M/S ANADARA, built for Anglo-Saxon Petroleum Company by Harland & Wolff, Ltd.

The Nederlandsche Koloniale Tankvaart Maatschappij (Netherlands Koloniale Tankship Company), which likewise is affiliated with Standard-Vacuum Oil Company, is building at the Rotterdam Drydock Company's yards a smaller twin screw steam tanker, the S/S BENAKAT for its Netherlands Indies service. Two reciprocating steam engines capable of developing 2600 H.P. with 2 single ended Scotch Marine boilers are being installed in this vessel. The addition of the BENAKAT will make a total of four vessels of practically similar characteristics owned and operated by this company in the Netherlands Indies service.

Other orders placed early in 1934 with the Kockums Yard in Malmo involved tramp tonnage. At this time, too, the Nakskov Shipyard received an interesting contract from Buenos Aires for a tanker for River Plate work. This is a Diesel engined ship in contrast to a number of similar orders placed. She is fitted with a Burmeister and Wain engine. Another small tanker of coastwise type was ordered by the North Star Line from the Oresund Shipbuilding Co. of Landskrona, an Atlas Polar single-acting 2-cycle engine being used in this case. A number of other tramp tankers were ordered during the next few months, and in April 1934 an 18,500 tonner was placed by the Cie. Auxiliare de Navigation of Paris with the Ateliers et Chantiers de la Seyne at Le Trait near Le Havre. This vessel is one of the biggest tankers yet ordered. The tankers placed during the remainder of the year, as will be seen from the accompanying table, were to a great extent of tramp type, although one or two special units were ordered. In particular, the Texas Company of Norway placed orders in June of last year for a 12,400 tonner with the Nakskov Shipbuilding Co. The expansion of the Texas Company with regard to building its own units for European work is a feature of tankship construction worth remarking on. In June 1934 the Iino Shoji Kaisha placed with the Kawasaki Dockyard Co. an order for two of the fast tankers of about 18 knots loaded speed which will make them available for use as naval auxiliaries. Japan, in fact, is the only nation which so far has shown any inclination either to build for its own navy or to support owners who are willing to build fast special tankers for naval work. The tankers possessed by the British Admiralty, for example, or chartered by them, are definitely of old steam type and would scarcely be capable of accompanying the fleet to sea in any national emergency. France has one or two special naval tankers, one of which recently has been re-engined, but even these are of ordinary mercantile type as regards speed. Built several years ago, they are only capable of about 11½ knots in service maximum. The situation as regards the United States fleet and tanker co-operation is well known. Any developments which may take place in the direction of encouraging higher speeds undoubtedly will be watched with a great deal of interest by the Admiralties of all nations.

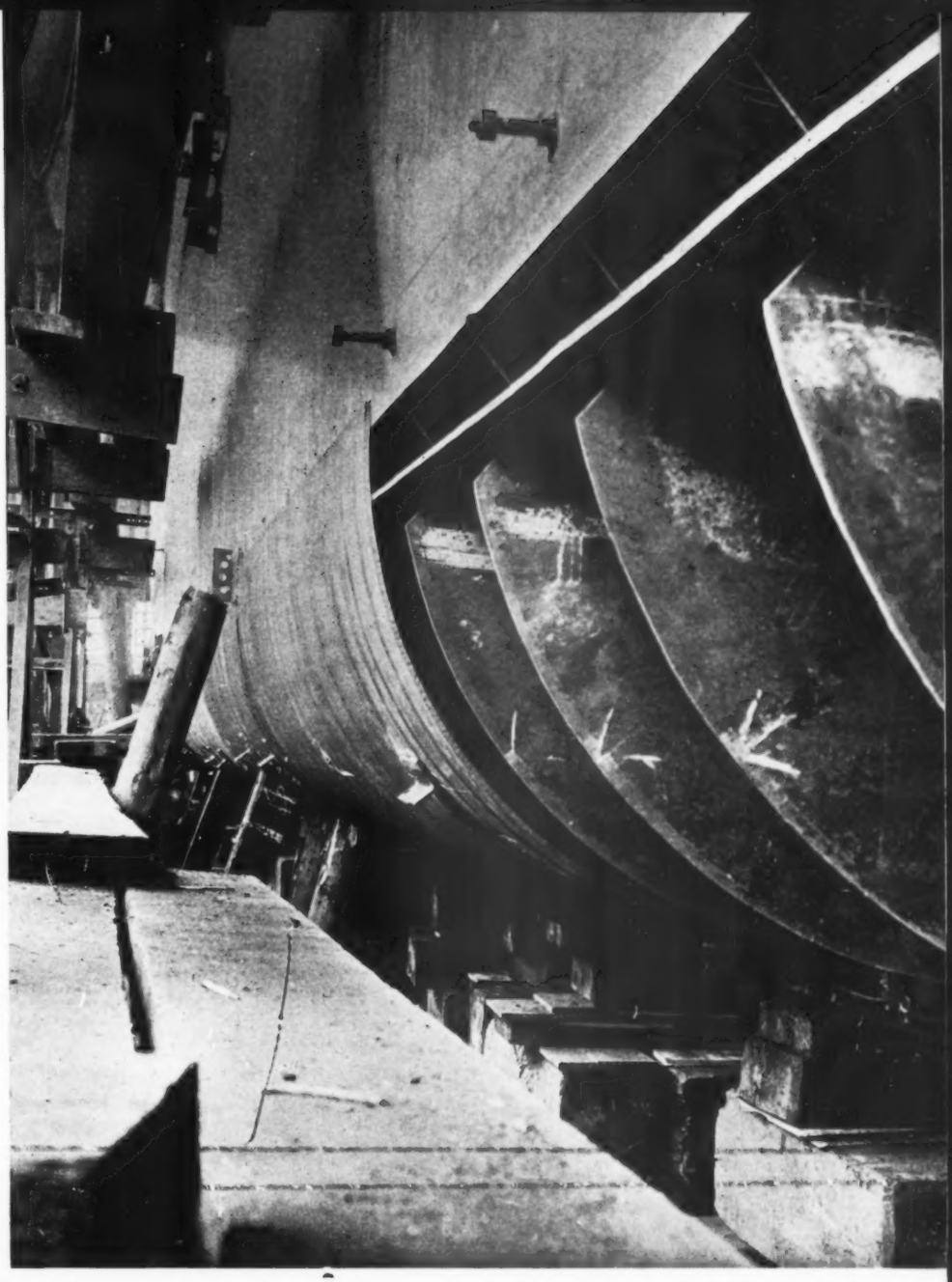
In the line of new construction the principal activity in the United States during the past year has been the completion of Socony-Vacuum Oil Company's fleet which has involved the launching of five vessels since June 1934. The latest of these is the MAGNOLIA, which was launched April 2 at the yards of the New York Shipbuilding Company at Camden, N. J.

The MAGNOLIA is 484 ft. long, 15,050 tons deadweight, and has a cargo capacity of 5,330,000 gallons. She has steam turbine drive and a designed speed of 12½ knots. She is equipped with the latest aids to navigation, including Sperry gyro compass and pilot, radio direction finder, short and long wave radio communication, fathometer and numerous safety devices in connection with the high pressure superheated steam propelling power plant.

A sister ship of the MAGNOLIA is the SOCONY-VACUUM completed late in 1934. In addition the company has put into commission three smaller tankers for canal and river transportation. One of these, the POUGHKEEPSIE-SOCONY, built

last year by United Dry Dock Company, is the largest all-welded merchant vessel constructed in the United States. Her gross tonnage is 1,242 and she has a capacity of 13,500 bbl. She is driven by 375 b.h.p. Diesel engines of the direct, reversible, air-injection type. Companion vessels are the NEW HAVEN SOCONY and PLATTSBURGH SOCONY, completed earlier last year.

The present year has proved a fairly fruitful one for shipyards of Europe as far as important new orders are concerned. The German subsidiary of Standard New Jersey—the German American Petroleum Co.—has placed orders which have been eagerly sought after, not only by German yards but by the majority of principal European shipbuilding centres. The Anglo-American Oil Co. has been talking bids but has not yet ordered. So far, a total of six ships have been placed, two of which are small 6,000-tonners with steam propulsion of a type which could be employed usefully in the Lake Maracaibo trade. The large vessels are 15,000 tonners, 485 ft. x 69.75 ft. x 37 ft., having a loaded speed of 11½ to 12 knots. They will be propelled by two sets of eight cylinder Krupp single-acting Diesels and are distributed between the Krupp Germaniawerft yard, the Blohm and Voss yard, Hamburg, the Weser yard, Bremen, and the Schichau yard in Elbe. The whole of the six ships except one has been placed in Germany and this one, which officially is intended for the Dutch Colonial Tank Shipping Co., is under construction at the yard of the Rotterdam Dry Dock Co. In February came the long awaited announcement of another "mass" order by the Anglo-



Welding the plates on the Moira; Quasi-arc mild steel and uranium electrodes were used.

Simplex balanced rudder on a Shell tanker under construction by Deutschen Werft at Hamburg.

Saxon Petroleum Co. This order was as interesting as it was welcome, because it came at a time when the 1933 program was only in process of completion. It concerned a total of twelve ships, two of which were 12,100 tonners of similar type to the ANCYLUS class which formed the whole of the 1933 order, and the rest 9,100 tonners, slightly smaller and intended for work to some of the Baltic ports. Like the larger vessels, however, the smaller units are also to be fitted with a Werkspoor 4-cycle, single-acting airless injection engine, each with 2,800 b.h.p. The building distribution here, as before, has been international. The Netherland Shipbuilding Co., Amsterdam, has obtained the order for two 12,100 tonners, while among the smaller ships Dutch yards have again been successful in that the De Schelde yard at Flushing had an order for one, this being the first time that the yard has built for the Anglo Saxon Co. The Rotterdam Dry Dock, almost the home of tanker construction in Holland to-day, received one and so too, did the Odense Shipyard in Denmark which in addition to constructing tankers for A. P. Moller, also built a vessel for the 1933 Anglo Saxon program. The United Adriatic Shipyards obtained one ship, the Wilton Shipyard two, and as regards the English

Tankers Ordered from August 1933 to June 1935

Owners	Builders	Deadwt. Cap. Tons	Engines	L, B, D	Designed Speed (Knots)	Power
London Owners	Blythswood Shipbuilding Co., Blythswood, Scotland	1,500 gr.	Rowan Triple expansion oil-fired boilers			
Anglo-Saxon Petroleum Co., London	Swan Hunter & Wigham Richardson Ltd., Wallsend-on-Tyne	12,000	S.A. 4-cycle Werkspoor supercharged Diesels	460′ x 59′ x 34′	12½	
Anglo-Saxon Petroleum Co., London	Bremer Vulkan Schiffbau & Maschinenfabrik, Vegesack, Germany	12,000	S.A. 4-cycle M.A.N. supercharged Diesel	460′ x 59′ x 34′	12½	3500 S.H.P.
N. V. Petroleum Maats. "La Corona" The Hague	Rotterdam Dry Dock Co., Rotterdam, Holland	12,100	S.A. 4-cycle Werkspoor supercharged Diesel	460′ x 59′ x 34′	12½	3,600 S.H.P.
Petr. Mij. La Corona, The Hague	Netherland Shipbuilding Company, Amsterdam, Holland	12,100	S.A. 4-cycle Werkspoor supercharged Diesels	460′ x 59′ x 34′	12	4,400 S.H.P.
Anglo-Saxon Petroleum Co., London	Odense Staalskibsvaerft, Odense, Denmark	12,100	S.A. 4-cycle Werkspoor supercharged Diesels	460′ x 59′ x 34′	12½	
Anglo-Saxon Petroleum Co., London	Cantieri Riuniti dell Adriatico, Monfalcone, Italy	12,100	S.A. 4-cycle Werkspoor supercharged Diesels	460′ x 59′ x 34′	12½	
Anglo-Saxon Petroleum Co., London	Deutsche Werft, A. G. Hamburg, Germany	12,100	S.A. 4-cycle Werkspoor supercharged Diesels	460′ x 59′ x 34′	12½	
Anglo-Saxon Petroleum Co., London	Harland & Wolff Ltd., Belfast, Ireland	12,100	S.A. 4-cycle Werkspoor supercharged Diesels	460′ x 59′ x 34′	12½	
Anglo-Saxon Petroleum Co., London	Workman Clark Ltd., Belfast, Ireland	12,100	S.A. 4-cycle Werkspoor supercharged Diesels	460′ x 59′ x 34′	12½	
Anglo-Saxon Petroleum Co., London	Lithgows Limited, Port Glasgow, Scotland	12,100	Kincaid—B. & W. S.A. supercharged Diesels	460′ x 59′ x 34′	12½	3,500 S.H.P.
Royal Dutch Shell Group, London	Wilton-Fijenoord, N. V. Rotterdam, Holland	12,100	Fijenoord-M.A.N. 4-cycle supercharged Diesel	460′ x 59′ x 34′	12½	3,600 S.H.P.
Anglo-Saxon Petroleum Co., London	Howaldstwerke A. G., Kiel, Germany	12,100	Werkspoor S.A. 4-cycle supercharged Diesel	460′ x 59′ x 34′	12½	
Eagle Oil & Shipping Company, Ltd., London, England	Swan Hunter & Wigham Richardson Ltd., Wallsend-on-Tyne	11,000	Werkspoor S.A. 4-cycle supercharged Diesel	442′ 6″ x 60′ 3″ x 32′	12	
Eagle Oil & Shipping Company, Ltd., London, England	R. & W. Hawthorn Leslie & Co., Hebburn-on-Tyne, England	11,000	Hawthorn-Werkspoor S.A. 4-cycle supercharged Diesel	442′ 6″ x 60′ x 32′	12	3,600 S.H.P.
Eagle Oil & Shipping Company, Ltd., London, England	Furness Shipbuilding Co., Haverton-Hill-on-Tees	11,000	Werkspoor S.A. 4-cycle supercharged Diesel	442′ 6″ x 60′ x 32′	12	
Eagle Oil & Shipping Company, Ltd., London, England	Harland & Wolff Ltd., Belfast, Ireland	11,000	Werkspoor S.A. 4-cycle (Harland-B. & W.) supercharged Diesel	442′ 6″ x 60′ x ?2′	12	
Eagle Oil & Shipping Company, Ltd., London, England	Lithgows, Ltd., Port Glasgow, Scotland	11,000	Kincaid-B. & W. S.A. supercharged Diesels	442′ 6″ x 60′ x 32′	12½	3,500 S.H.P.
Eagle Oil & Shipping Company, Ltd., London, England	Blythswood Shipbuilding Co., Blythswood, Scotland	11,000	Werkspoor S.A. 4-cycle supercharged Diesel	442′ 6″ x 60′ x 32′	12	
Cia. Transp. de Petrol, Buenos Aires, Argentine	Furness Shipbuilding Co., Haverton-Hill-on-Tees	1,950	Steam-driven, triple-expansion and Scotch boilers			
Argentine Government. (Yacimientos Petroles Fiscales), Buenos Aires, Argentine	Deutsche Werft A. G., Hamburg, Germany	10,000	Steam-driven, triple-expansion and Scotch boilers			
Standard Vacuum Transportation Co., New York, U. S. A.	Rotterdam Dry Dock Co., Rotterdam, Holland	15,000	Fried Krupp, S.A. 4-cycle Deisel	485′ x 75′ 10″ x 37′		3.500 S.H.P.
Standard Vacuum Transportation Co., New York, U. S. A.	Fried Krupp. Germaniawerft, Kiel Gaarden, Germany	15,000	Fried Krupp, S.A. 2-cycle Diesel	485′ x 68′ x 37′	12½	3,600 B.H.P.
A/s. Dovrefjell, Oslo, Norway	Kockums Mek. Verkstads, Malmo, Sweden	12,500	Kockums-M.A.N. Diesel	460′ x 59′ 6″ x 34′ 7″	12	3,450 S.H.P.
A/s. Havprins, Oslo, Norway	Kockums Mek. Verkstads, Malmo, Sweden	12,500	Kockums-M.A.N. Diesel	460′ x 59′ 6″ x 34′ 7″	12	3,450 S.H.P.
S. H. Smith Sorensen, Arendal, Sweden	Kockums Mek. Verkstads, Malmo, Sweden	12,500	Kockums-M.A.N. Diesel	460′ x 59′ 6″ x 34′ 7″	12	3,450 S.H.P.
Ultramar. Soc. Petrolera Argentina, Buenos Aires, Argentine	Nakskov Skibsvaerft Akt., Nakskov, Denmark	2,300	Burmeister & Wain Diesel	260′ x 41′ x 18′	11	1,150 I.H.P.
North Star Line, Stockholm, Sweden	Oresund Shipbuilding Co., Landskrona, Sweden	530	Atlas-Polar S.A. 2-cycle Diesel	150′ x 27′ x 12′ 3″	10	400 S.H.P.
Leif Hoegh, Oslo, Norway	Eriksbergs mek. Verksted, Gothenburg, Sweden	12,500	Eriksbergs—B. & W. d.a. 2-cycle Diesel	465′ x 60′ 9″ x 34′ 7″	12	
Martin Mosvold, Farsund, Norway	Burmeister & Wain, Copenhagen, Denmark	14,700	B. & W. 2-stroke S.A. Diesel	470′ x 64′ 2″ x 35′	12	
Anglo-Saxon Petroleum Co., London, England	Netherlands Shipbuilding Co., Amsterdam, Holland	3,350	Werkspoor, triple-expansion and W. T. boilers	335′ x 56′ x 14′ 6″	10	2,500 I.H.P.
Anglo-Saxon Petroleum Co., London, England	Netherlands Shipbuilding Co., Amsterdam, Holland	3,350	Werkspoor, triple-expansion and W. T. boilers	335′ x 56′ x 14′ 6″	10	2,500 I.H.P.
Sigval Bergesen, (A/s. Sneford), Stavanger, Norway	Odense Staalskibsvaerft, Odense, Denmark	14,250	Burmeister & Wain Diesel		11½	

Owners	Builders	Deadwt. Cap. Tons	Engines	L, B, D	Designed Speed (Knots)	Power
Cie. Aux. de Nav, Paris, France	Ats. & Chants. de la Seine (Worms & Co.) Le Trait, France	18,500	Burmeister & Wain Diesel	166 M. 200 x 21 M. 800 x 12 M.	12½	8,800 I.H.P.
Tank Rederi Tonnevold A/s. Grimstad, Norway	Götaverken A/b., Gothenburg, Denmark	15,300	Götaverken—B. & W. Diesel	510′ 6″ x 64′ x 29′ 3″		2,400 S.H.P.
Sigval Bergensen, (A/s. Dalfonn), Stavanger, Norway	Odense Staalskibsvaerft, Odense, Denmark	14,200	Burmeister & Wain Diesel			
Jorgen P. Jensen, Arendal, Sweden	Burmeister & Wain, Copenhagen, Denmark	14,700	Burmeister & Wain Diesel	470′ x 64′ 2″ x 35′	12	
Socony-Vacuum Corporation, New York, U. S. A.	New York Shipbuilding Co., New Jersey, U. S. A.	15,050	Steam turbines and W. T. boilers	484′ x 65′ 9″ x 37′	11½	4,000 S.H.P.
Socony-Vacuum Corporation, New York, U. S. A.	United Dry Dock Co., New York, U. S. A.	1,930	McIntosh and Seymour S. A. 4-cycle Diesels	260′ x 40′ x 14′	10	750 B.H.P.
J. L. Mowinckels Rederi, Bergen, Norway	Götaverken A/b., Gothenburg, Sweden	12,000	Götaverken—B. & W. S. A. 4-cycle Diesel	473′ x 59′ x 35′ 6″	12	
Rederi A/b. Freikoll, Oslo, Norway	Götaverken A/b., Gothenburg, Sweden	12,000	Götaverken—B. & W. S. A. 4-cycle Diesel	473′ x 59′ x 35′ 6″	12	
A. P. Moller, Copenhagen, Denmark	Odense Staalkisbaverft, Odense, Denmark	12,750	Burmeister & Wain Diesel		12	
Ostlandske Petroleum Co., Oslo, Norway. (Standard Oil Co. of N. J.)	Akers mek. verksted, Oslo, Norway	9,900	Akers—B. & W. Diesel	407′ x 56′ x 33′ 6″	11	3,100 I.H.P. approx.
Soviet Republic, Moscow, U. S. S. R.	Sormovo Works, Sormovo, U. S. S. R.	7,600	Sormovo Diesel		11½	
Iino Shoji Kaisha, Tokyo, Japan	Kawasaki Dockyard, Kobe, Japan		M. A. N. Diesel	526′ 6″ x 65′ x 37′	18½	
Gulf Refining Co., Pittsburg, U. S. A.	Bethlehem Sb. Co., Sparrows Point, Maryland, U. S. A.	15,400	McIntosh & Seymour Diesel		10	
S/d. Skien, Skien	K. Christensen, Moen, Norway	100			8	
Texas Co. (Norway) Ltd., New York, U. S. A.	Nakskov Shipbuilding Co., Nakskov, Denmark	12,400	Burmeister & Wain 4-stroke S. A. Diesel	460′ x 59′ 6″ x 34′	11½	4,100 I.H.P.
Julius Schindler, Hamburg, Germany	Werft Nobisskrug, Rensburg, Germany	2,100	M. A. N. 900 B.h.p. Diesel	245′ x 37′ 6″ x 5′ 3″	9	
Stettiner Oel Kontor, G.m.b.H., Berlin, Germany	Schiffswerft D. W. Kremer Sohn, Elmshorn, Germany	275	Bohn & Kahler 6-cyl. direct reversible 4-stroke Diesel		10	300 S.H.P.
Benzine Transport Co., Stockholm, Sweden. (A/s. Sveiseindustri)	Finnboada Works, Stockholm, Sweden	147 cu. m.	Diesel	75′ x 18′ x 7′	7	128 B.H.P.
Oslo Owners, Norway	(Not available)	15,000			11½	
Olof Wallenius, Stockholm, Sweden	Eriksbergs mek. Verksted, Gothenburg, Sweden	540			9	
Norwegian Whaling Co., Oslo, Norway	Bremen Vulkan Schiffbau & Maschinenfabrik, Vegesack, Germany	14,500	M.A.N. D.A. 2-cycle Diesel	483′ 6″ x 65′ 9″ x 35′ 11″	12	4,100 S.H.P.
Bruun & Von der Lippe, Tonsberg	Deutsche Werft, Hamburg, Germany	14,500	A.E.G. Hesselman S.A. 2-stroke Diesel	483′ 6″ x 65′ 9″ x 35′ 11″	12	
S. A. De Petroles Congo, Brussels, Belgium	Rotterdam Dry Dock, Rotterdam, Holland	320		161′ 3½″ x 23′ x 6′ 1″		
A/s. Mosvold Rederi, Farsund, Norway	Eriksberg mek. Verksted, Gothenburg, Sweden	12,500	B. & W. Götaverken Diesel	482′ x 60′ 9″ x 34′	12	3,500 S.H.P.
A/s. Navalis, Oslo, Norway	Kockums mek. Verksted, Malmo, Sweden	14,500	Kockums—M.A.N. Diesel	490′ x 63′ x 36′ 7″	13	4,500 S.H.P.
Van den Bergh Margarine A. G., Berlin, Germany	Howaldtswerke A. G., Kiel, Germany	6,000			10	
A. P. Moller, Copenhagen, Denmark	Odense Staalskibsvaerft, Odense, Denmark	14,500			11½	
D/S Marna Co., Oslo	Swan Hunter & Wigham Richardson, Ltd., Wallsend-on-Tyne	2,240	Turbo-compound Bauer Wach system	245′ x 42′ 2″ x 18′	10	
Trelleborgs Nya Angfartygs. a.b., Trelleborg, Sweden	Oresunds varvet, Landskrona, Sweden	530	Polar Diesel	150′ x 27′ x 12′ 3″	10	400 S.H.P.
Yacimientos Petroliferos Fiscales, Buenos Aires, Argentine	Hansem & Puccini, Buenos Aires, Argentine		Sulzer S.A. 2-stroke Diesel		12	
Deutsche Amerikanische Petroleum A.G.	Howaldstwerke A.G., Kiel, Germany	6,000			10	
Deutsche Amerikanische Petroleum A.G.	Fried Krupps Germaniawerft, Kiel-Gaarden, Germany	15,000	Krupp S.A. Diesel	485′ x 69′ 9″ x 37′	11½–12	
Deutsche Amerikanische Petroleum A.G.	Blohm & Voss, Hamburg, Germany	15,000	Krupp S.A. Diesel	485′ x 69′ 9″ x 37′	12	
Deutsche Amerikanische Petroleum A.G.	Deschimag (A.G. Weser), Bremen, Germany	15,000	A.G. Weser-M.A.N. Diesel	485′ x 69′ 9″ x 37′	11½–12	
Deutsche Amerikanische Petroleum A.G.	F. Schichau, Elbing, Germany	15,000	Schichau-Sulzer Diesel	485′ x 69′ 9″ x 37′	11½–12	

Owners	Builders	Deadwt. Cap. Tons	Engines	L, B, D	Designed Speed (Knots)	Power
Nederlandsche Koloniale Tankvaart Maatschappij, The Hague, Holland	Rotterdam Dry Dock Co., Rotterdam, Holland	6,000	Triple expansion (twin screw)	360′ x 64′ x 18′		2,300 I.H.P.
Bataafsche Petr. Mij., The Hague	Netherlands Shipbuilding Co., Amsterdam, Holland	12,100	Werkspoor S.A. 4-cycle supercharged Diesel	460′ x 59′ x 34′	12	4,400 S.H.P.
Bataafsche Petr. Mij., The Hague	Netherlands Shipbuilding Co., Amsterdam, Holland	12,100	Werkspoor S.A. 4-cycle supercharged Diesel	460′ x 59′ x 34′	12	4,400 S.H.P.
Anglo-Saxon Petroleum Co., London, England	Kon. My. "De Schelde" Vlissingen, Holland	9,100	Werkspoor 4-cycle Diesel	425′ x 54′ 3″ x 31′	12	2,800 S.H.P.
Anglo-Saxon Petroleum Co., London, England	Rotterdam Dry Dock, Rotterdam, Holland	9,100	Werkspoor 4-cycle Diesel	425′ x 54′ 3″ x 31′	12	2,800 S.H.P.
Anglo-Saxon Petroleum Co., London, England	Odense Staalskibsvaerft, Odense, Denmark	9,100	Werkspoor 4-cycle Diesel	425′ x 54′ 3″ x 31′	12	2,800 S.H.P.
Anglo-Saxon Petroleum Co., London, England	Cantieri Riuniti dell' Adriatico, Monfalcone, Italy	9,100	Werkspoor 4-cycle Diesel	425′ x 54′ 3″ x 31′	12	2,800 S.H.P.
Royal Dutch-Shell Group, London, England	Wilton Fijenoord, N.V., Rotterdam, Holland	9,100	Fijenoord—M.A.N. 4-cycle Diesel	425′ x 54′ 3″ x 31′	12	2,800 S.H.P.
Royal Dutch-Shell Group, London, England	Wilton Fijenoord, N.V. Rotterdam, Holland	9,100	Fijenoord—M.A.N. 4-cycle Diesel	425′ x 54′ 3″ x 31′	12	2,800 S.H.P.
Anglo-Saxon Petroleum Co., London, England	Swan Hunter & Wigham Richardson Ltd., Wallsend-on-Tyne, England	9,100	Hawthorn Leslie-Werkspoor Diesel	425′ x 54′ 3″ x 31′	12	2,800 S.H.P.
Anglo-Saxon Petroleum Co., London, England	Harland & Wolff Ltd., Belfast, Ireland	9,100	Harland—B. & W. Diesel	425′ x 54′ 3″ x 31′		
National Benzole Co. Ltd., London, England	Rowhedge Ironworks Ltd., Rowhedge, Nr. Colchester, England	125	Atlas Diesel	95′ x 19′ x 8′ 9″	8	180 S.H.P.
Ivor Bugge (A/S Nanset), Larvik, Norway	Götaverken A/B, Gothenburg	14,500	B. & W. D.A. Diesel	507′ x 64′ x 37′	12½	5,200 I.H.P.
Ludo G. Braathen, Oslo, Norway	Kockums Mek. Verkstad A/B, Malmo, Sweden	14,500	Kockums—M.A.N. Diesel	490′ x 62′ 9″ x 36′ 7″	13	4,500 S.H.P.
A.T.P.G.	F. Schichau, G.m.b.H., Elbing, Germany	15,000	Schichau-Sulzer Diesel	483′ x 69′ 9″ x 37′	12½	3,600 B.H.P

Reports received too late for inclusion in the above table indicate that Rhenania Ossag Mineraloel Werke of Hamburg, Germany, have just placed three further orders; one for a 12,100 tonner for 12 knots with Deutsche Werft; one for a 12,100 tonner, 12 knots with Bremer Vulcan, and one for a 9,250 tonner at the Howaldswerke.

yards, four ships were divided respectively between Messrs. Swan Hunter and Messrs. Harland & Wolff.

Mention of the former yard calls to mind the fact that they are now specialising very much in welded construction in which indeed they have done a great deal of successful pioneer work. One such ship, the MOIRA, building for the Marna Co. of Oslo, was recently launched. She was ordered toward the end of last year and has a deadweight capacity of 2,240 tons, being steam propelled and having dimensions 245 ft. x 42.2 ft. x 18 ft. Quasi-Anc mild steel and uranium electrodes were used throughout the vessel. She is said to be the largest all-welded ocean going ship built in Great Britain; in this connection it will be recalled that in 1933 Messrs. Swan Hunter built for the Canadian oil industry the 750 ton PETER G. CAMPBELL which is an all welded barge for work on the Great Lakes.

In the construction of the MOIRA as the new ship is called the builders have adopted the methods of layout and direction which were so successfully carried out in the case of the barge. It is interesting to note in view of modern developments, that the propulsion in this case comprises a steam reciprocating engine of compound type, in conjunction with a Bauer Wach exhaust steam turbine. Two single-ended Scotch boilers, fitted for burning coal or oil provide steam at 210 lbs. per sq. inch.

Up to the time of writing, since the last Anglo Saxon Co.'s mass order, only two small orders have been placed. One in March by the National Benzole Co. of London with a small British shipyard is for a 135 tonner fitted with an Atlas 2-cycle Diesel. This ship has dimensions 95 ft. x 19 ft. x 8.75 ft. and is the third modern motortanker, owned and specially built for this enterprising company which, as is well known, is all British in character and depends largely upon coal derivatives for the manufacture of its products. An order for a 14,500 tonner of tramp type has also been placed with a Swedish shipyard by Norwegian owners.

This, then, is a brief survey of the tanker orders placed since what we have described as a recovery in the market, began to take place. Do these orders reveal any particular improvement on previous orders? Do they show an appreciation of the improvements which have been made in marine propulsion? Do they indicate any particular desire to speed up these carriers of cargoes which are and always will be essentially those for which there is a continuous supply and continuous demand? Do they show that any new companies are breaking into the tanker building field or that ownership is expanding? Do they indicate that the owners of liner ships are beginning to order rather than those of tramps? These are random questions which occur as a result of a perusal of the annexed table and with regard to the latter question, we may answer definitely that at present the larger orders are coming from what may be termed the liner owners. This, as regards the Anglo Saxon Co., is perhaps a somewhat erroneous name, but it does include those companies which control their services on liner principles even though the same ship may not make the same voyage twice running in the year. As regards the Anglo Saxon Co., it would appear that so successful have been the ships of ANCYLUS class and so far do they represent the peak of modern development, that the new ships do not show any great departure from them.

The secret of the success of the new Anglo Saxon vessels, and it is impossible to overestimate this point, lies in the self-containedness of their main engine room and the fact that the whole of the auxiliary machinery when the ship is at sea can be operated from the exhaust gas of that main engine. It is interesting in view of the developments which have taken place in the Diesel engine, particularly as regards the 2-cycle system of operation to note that the Anglo-Saxon Co. keeps, not only to the 4-cycle system of operation but to the same make of engine, namely the Werkspoor which has characterized its fleet from the VULCANUS, whose hull has now been destroyed but whose engine is still operating.

For the first time since the PHOBOS class, completed in December 1926, the Anglo Saxon Co. has returned to single-screw powering, but whereas on this particular class the speed was given by a double-acting 4-cycle unit of airless injection type, on the new ship it is given by a single-acting 4-cycle engine of air-injection type with continuous supercharge. Special arrangements are made whereby the whole of the pumps which the engine itself requires are driven from that engine. The only other auxiliaries required when the vessel is at sea is a refrigerating machine, a steering engine and at night, of course, a lighting engine. These can easily be supplied with sufficient steam generated by the exhaust in a Scotch boiler at the forward end of the engine room on a special flat. When the ship is in port, ample steam for pumping and for tank steaming or heating as necessary can be supplied by the Scotch boiler equipment whereas an engine of crankcase compression type is used for driving a small generator to supply the necessary lighting. A speed of at least 12½ knots in service is given by these new Anglo Saxon ships. This represents the acme of sea speeds for this type of vessel, and certainly on a single screw. The speed is attributable to the careful attention which has been given to hull design and also to the power which the engines can deliver. Will this speed be improved upon future programmes and if it is, how far will it tend to render existing ships obsolescent? From a pure shipbuilding point of view, the future of tanker construction depends upon two factors:

1. The increase in speed which will make it necessary either to re-engine older ships or to re-build entirely and

2. The effect of various oil cargoes upon the structure of the ship itself.

▼

Single screw motor tanker W. B. Walker being built for Oriental Tankers Ltd., (affiliated with Standard-Vacuum) at the yard of Fried Krupp

Corrosion Resisting Alloy

A NEW alloy has recently been developed in Great Britain designed to overcome the ravages of corrosion in oilfield, refinery and transportation equipment. While the cost of the new material is several times that of mild steel it has proved truly economical in view of the fact that its useful life is reported as twenty times as long as mild steel when used in casing for a well producing crude of high sulphur content.

The alloy, known as Tungum, is being studied by engineers of a large international oil company. These studies reveal that Tungum Alloy is useful for tankers where exposed to rapid corrosion, in refineries on parts exposed to acid, corrosive petroleum products, caustics, etc., as well as in oil well work.

Official approval of the new alloy has been accorded by Lloyd's Register of Shipping and attention is called to its resistance to impact, stress and fatigue. Tungum is used on the complete stern gear of PENOLA, dispatched by the Royal Geographical Society in 1934 for three years' exploration of the antarctic.

Oil well casing of Tungum has proved successful in resisting corrosion in Roumania, Burmah and Argentina.

The Tungum Alloy Sales Co. is experimenting with a process for spraying finely divided particles of the metal on to surfaces exposed to corrosion. Where the metal is used for construction purposes, welding practice is similar to other non-ferrous materials except that a Tungum filter rod is used.

Extensive Replacement Program Foreseen

Forty-four Percent Steam Tanker Tonnage Over Fifteen Years Old, Will Require Replacement in Next Five Years. Corrosion Problem Discussed.

*By Robert F. Hand**
Vice President, Standard
Shipping Company

THE QUESTION of tanker tonnage supply and demand is one which concerns both tanker owners and oil companies, being the crux of the tanker freight rate structure. The demand for tanker tonnage is governed by the sources of petroleum and its products and their proximity to the refining and marketing centers. This controls primarily the length and direction of the haul. Another factor is the cost of petroleum products and whether products in excess of normal consumption requirements are being transported and put into storage. The demand is also influenced by cross-hauls, due to competition between oil companies. The correct forecasting of the demand for tankers is a problem to be approached with trepidation and which, judging by the history of tanker freight rates, is prone to show surprising discrepancies between the forecasted and the actual demands.

In attempting to determine whether the supply of tanker tonnage is adequate for normal requirements during the next few years, it is necessary to know, in addition to the probable requirements, the age of existing tanker tonnage, the amount of new tonnage contracted for and under construction, and the nature and amount of tonnage laid up during this period of depression.

A study of Table I, in which as a matter of interest the figures for the United States are separated from those for the rest of the world, reveals the following interesting condition with respect to the percentage of tankers over 10 and 15 years of age:

	Over 10 Years of Age Percentage	Over 15 Years of Age Percentage
U. S. Steam	97	43
U. S. Motor	33	13
Total U. S.	89	39
Other Steam	75	45
Other Motor	8	3
Total Outside U. S.	41	24
World's Steam	85	44
World's Motor	10	4
Total World's	56	29

*Condensed from a paper delivered before the North-East Coast Institution of Engineers and Shipbuilders.

Inasmuch as 44 percent of the world's steam tonnage is over 15 years of age, it is self-evident that during the next five years new construction will have to be undertaken to replace the unserviceable tonnage.

The curves in Fig. 1 show the fluctuations in oil production, consumption, tanker tonnage and the freight rates U. S. Gulf/U. K. Continent for clean tonnage covering the period from January 1, 1922, up to the end of 1934. Particular attention is directed to the wide fluctuations in freight rates, the curves consisting of high peaks and deep valleys which give some indication of the futility of attempting to forecast freight rates and correlate the amount of tonnage under construction with anticipated demand. However, it would seem from these curves that whenever there is a wide gap between the amount of tonnage afloat and tanker tonnage in operation it corresponds to a period of low freight rates, whereas the closing of the gap between these two curves is followed by an increase in freight rates, which is represented by a sharp rise of the freight rate curve owing to the inelastic nature of the supply of tanker tonnage.

For the purposes of marine transportation, petroleum and its products may be conveniently classified as follows:

Grade "A." Petroleum products having a Reid vapour pressure of 14 lbs. per square inch or more.
This grade will include only casing-head and very volatile gasolines.

Grade "B." Petroleum products having a Reid vapour pressure less than 14 and more than 4½ lbs. per square inch.
This grade will include gasolines and the lighter crude oils.

Grade "C." Petroleum products having a "tag" closed flash point below 86 deg. and a Reid vapour pressure of 4½ lbs. per square inch or less.
This grade will include the majority of crude oils.

Grade "D." Petroleum products having a "tag" closed flash point of 86 deg. or more and a Pensky Martens flash point of 149 deg. F. or less.
This grade will include kerosene and certain distillates.

Bunker "C" fuel oil and Diesel fuel oil are required to have a flash point in excess of 150 deg. F. and they may be safely transported by tankers which are not necessarily equipped with elaborate venting systems.

Lubricating oils must be handled carefully to prevent contamination by other grades of oil or by water and moisture. In order to meet these conditions, the M. S. GENERAL GASSOUIN, and M. S. HANSEAT, employed in the transatlantic service, were specially constructed with built-in cylindrical tanks and each tank having its own pump and arrangement of piping to permit independent loading and discharging. The cylindrical tanks are not in contact with sea water, with the result that deterioration of lubricating oil due to the sweating of tanks is eliminated.

In order to transport Grade "A" safely, that is casing-head gasoline products, and to avoid large evaporation losses, we have found it desirable to carry that product under pressure, this being achieved by fitting pressure and vacuum valves in the cargo tank vents adjusted to

TABLE I

World's Tanker Tonnage Classified by Ages as of July 1, 1934

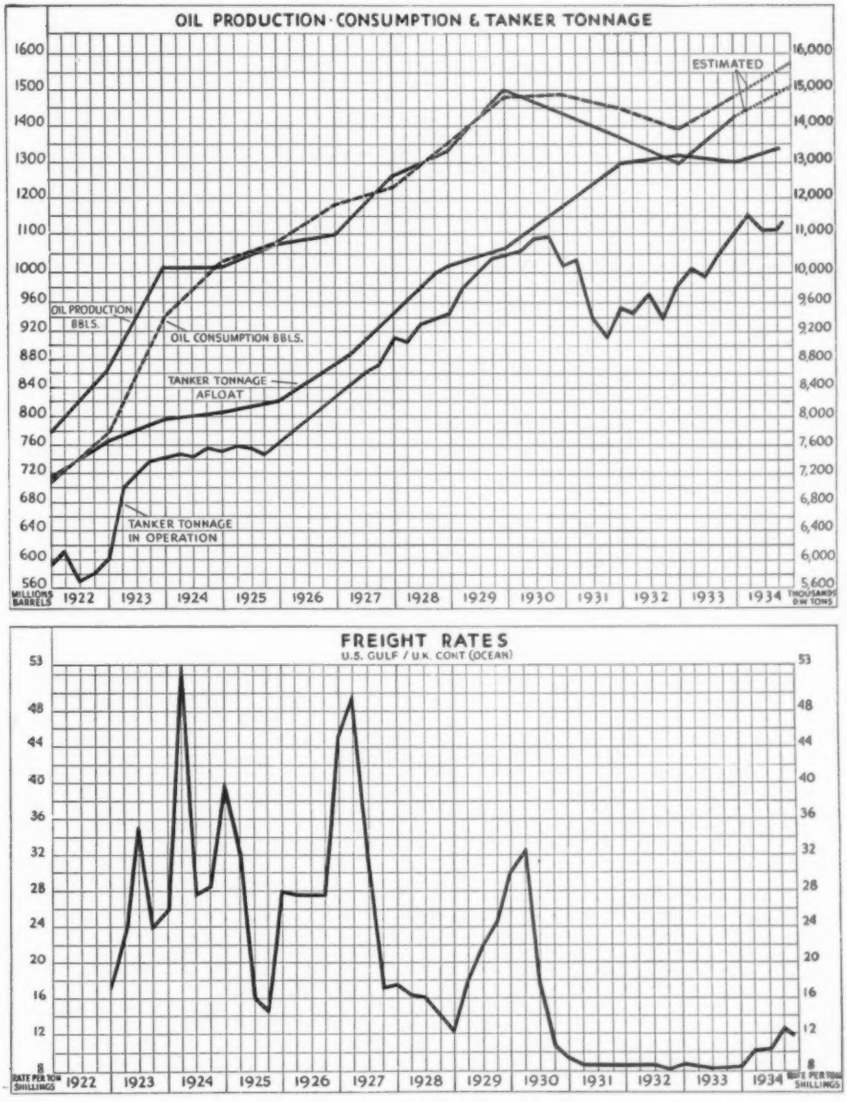
	Up to 5 Yrs.		6–10 Yrs.		11–15 Yrs.		16–20 Yrs.		21–25 Yrs.		Over 25 Yrs.		TOTAL.	
	No.	D.W.T.	No.	D.W.T.	No.	D.W.T.	No.	D.W.T.	No.	D.W.T.	No.	D.W.T.	No.	D.W.T.
U. S. Steam	7	105,224	2	20,222	174	1,937,760	122	1,279,342	29	217,621	11	56,272	345	3,616,441
U. S. Motor	14	154,570	18	178,944	12	99,888	9	63,016	1	2,150	1	2,050	55	500,618
Total U. S.	21	259,794	20	199,166	186	2,037,648	131	1,342,358	30	219,771	12	58,322	400	4,117,059
Other Steam	34	247,260	138	881,883	165	1,405,277	139	960,219	70	554,084	81	540,238	627	4,588,961
Other Motor	207	2,357,443	189	1,941,798	29	218,051	15	84,275	8	37,567	5	17,145	453	4,656,279
Total Outside U. S.	241	2,604,703	327	2,823,681	194	1,623,328	154	1,044,494	78	591,651	86	557,383	1,080	9,245,240
World's Steam	41	352,484	140	902,105	339	3,343,037	261	2,239,561	99	771,705	92	596,510	972	8,205,402
World's Motor	221	2,512,013	207	2,120,742	41	317,939	24	147,291	9	39,717	6	19,195	508	5,156,897
Total World	262	2,864,497	347	3,022,847	380	3,660,976	285	2,386,852	108	811,422	98	615,705	1,480	13,362,299

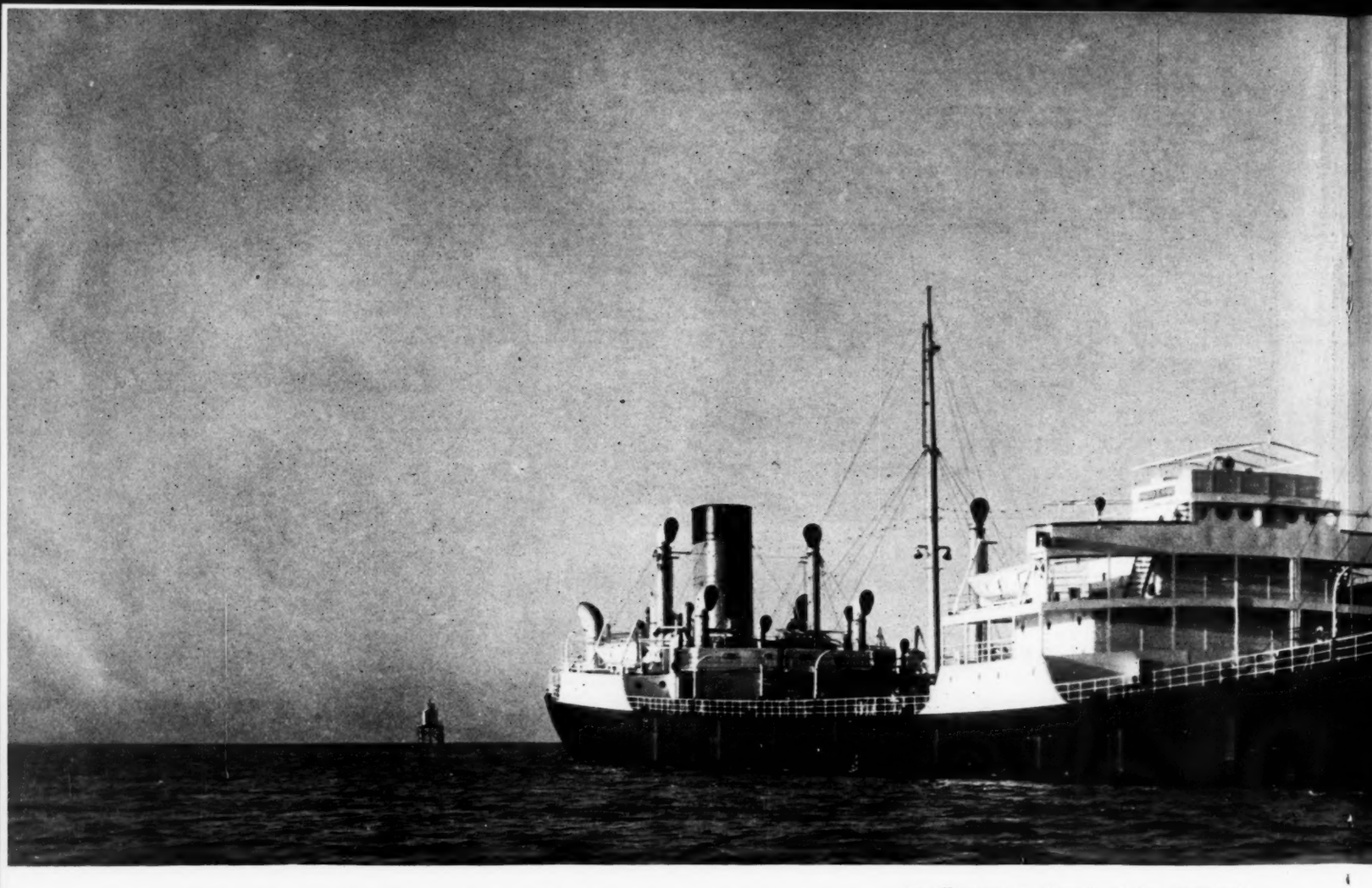
release at 4½ lb. pressure. The pressure within the tanks when loaded rises rapidly with increasing temperatures owing to the sún's rays and in order to cool the deck over these tanks, a sea-water spraying system is used. The outlets from the venting system are conducted into a common header having outlets up the mast fitted with flame arresters. A by-pass valve is fitted in the vent pipe branch from each tank in order that pressure may be released promptly. When loading these volatile products, a large volume of gas is liberated, these gases being conducted ashore through hose connected to the venting system.

It is our practice to carry ordinary gasoline on tankers having independent vents on each tank equipped with a pressure and vacuum valve set to release at 2½ lb. pressure. With these independent tank vents it is possible to carry different grades of gasoline and kerosene without incurring contaminations or the lowering of flash point of kerosene due to the condensate of lighter ends from the gasoline vapours draining back into tanks containing kerosene, the flash point of which must not be below 115 deg. F. in most cases. All our vessels are equipped with a steam smothering or CO_2 fire prevention and extinguishing system, these systems being so arranged that cargo contamination cannot readily occur. In our service we are called upon to carry large quantities of sour crudes containing hydrogen sulphide which has toxic properties. These vessels have been specially equipped with a common venting system consisting of branches from each cargo tank conducted into headers running up the mast and fitted with flame arresters at the outlets. It is our latest practice to fit these tankers with gas-tight hatch covers provided with two glazed ports for observing the level of the oil in the tanks. These venting systems are made large enough to take care of all gases displaced and liberated while loading cargo, with the result that the toxic gases are discharged at the top of the mast and the men concerned with loading the tanks are not exposed to them.

In order to eliminate the steaming of tanks with its obvious disadvantages of

Figure 1


OIL PRODUCTION · CONSUMPTION & TANKER TONNAGE
ESTIMATED
OIL PRODUCTION BBLS.
OIL CONSUMPTION BBLS.
TANKER TONNAGE AFLOAT
TANKER TONNAGE IN OPERATION
MILLIONS BARRELS
THOUSANDS D.W. TONS
1922 1923 1924 1925 1926 1927 1928 1929 1930 1931 1932 1933 1934
FREIGHT RATES
U.S. GULF / U.K. CONT (OCEAN)
RATE PER TON SHILLINGS



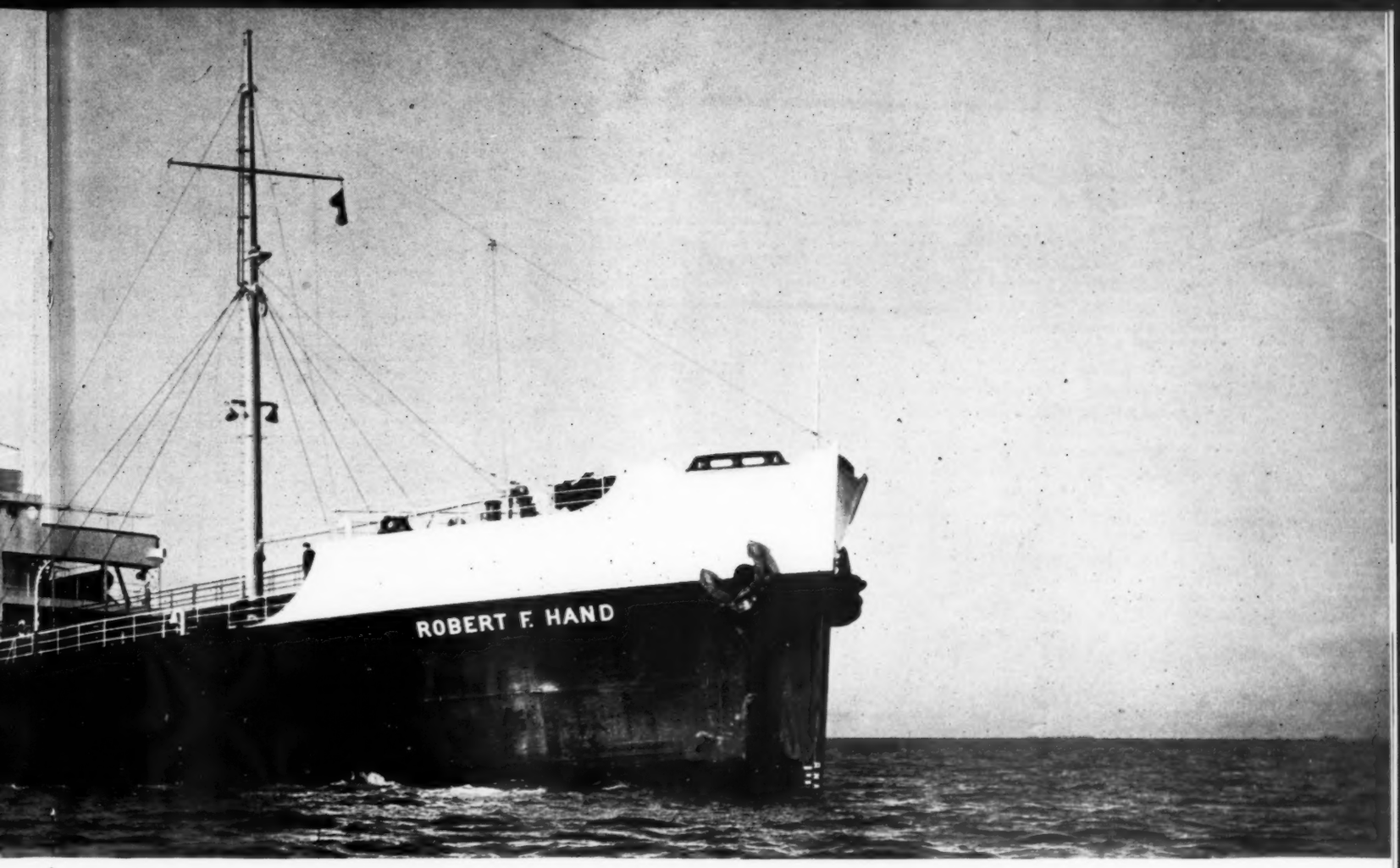
The "Robert F. Hand" of the Standard Shipping Company's fleet

straining and corrosion, the Standard Shipping Company has adopted on all its vessels the Butterworth System of tank cleaning which eliminates steaming and at the same time greatly reduces the cost of cleaning operations. With this system the tanks are washed by water heated to about 175 deg. F., and directed against the sides of the interior of the tanks in a solid stream at 160 to 180 lb. pressure from revolving nozzles. These nozzles turn slowly in horizontal and perpendicular planes, so that their position changes continually with each revolution, causing the stream to be directed eventually against all interior surfaces of the tank. The nozzles are part of a machine that is lowered down through an opening in the deck over the tank, and reaches down to about one-half the depth of the tank. During the cleaning operations the tank bottoms are kept free of water, thus realizing the full forces of the stream on the tank bottoms, which results in the breaking up of rust scale, so that it is pumped out with the water. When cleaning from black to refined oil, it is necessary to wash with kerosene or furnace oil, which is circulated through these special cleaning machines in the same way as the water. This system of tank cleaning by machine has proved entirely satisfactory, and has resulted in a great saving in time, as well as reducing the cost of cleaning tanks either for repair purpose or when changing from black-oil to clean-oil service. It is our experience that the time and cost of cleaning a black-oil ship for the clean service by means of the Butterworth machines is about 10 percent to 20 percent of the time and cost of similar results when using the old steam and hand-cleaning methods.

Problems of Corrosion

CORROSION, or the wasting away of the internal structure of cargo tanks of oil tankers is a very complex subject and has a very important bearing upon the design and operation of tankers. Generally speaking, corrosion is caused by the nature of the cargo carried in combination with the use of sea-water ballast, fatigue of material and to a somewhat lesser extent, the salt-laden atmosphere and sea water temperatures in which tankers operate. Present-day gasolines have a lower end point and contain less kerosene than in former years. This change in the nature of the product may to some extent account for the exceedingly rapid corrosion of tankers employed in the gasoline trade during the past decade. In considering this subject, one must, of course, take into account the quality of metal used in the structure, our experience having proven that there actually is a considerable difference in the corrosion-resisting qualities of certain steels; for instance, pre-War and post-War ship steel. This question of the relative merits of pre-War and post-War steel is, however, such a highly controversial subject that the present remarks on this matter will be confined to the one case regarding which we have definite knowledge.

Some years ago sections of hull plating were removed for test purposes from tankers constructed of pre-War and post-War steel. Much to our surprise, virtually no difference was found in the chemical and physical characteristics of the steel, although the fact remained that the pre-War built vessels were far less costly as regards structural upkeep. Subsequent examination of the microstructure of the steel showed differences in the degree of effectiveness with which the ingredients of the steel had been



puddled or mixed together. As a matter of fact, investigation showed that such differences in microstructure were not confined to steel coming from different heats and metals, but were actually found in steel coming from any one mill, even though the chemical and physical characteristics of all these steels were approximately the same. Such differences may be accounted for in many ways, but are often the result of imperfect rolling or too rapid and unequal cooling of the material. In any case, a favorable difference in the microstructure of the pre-War steel undoubtedly accounts for the better corrosion-resisting qualities of the pre-War built tanker as compared with its more modern prototype built during the War and during the early post-War period.

Many different kinds of structural metal, such as rustless and stainless steels, chrome-nickel steel, and copper-bearing iron and steel have been used for shell and bulkhead plating to determine their non-corrosive values, but in almost every instance these plates have deteriorated as fast, if not faster, than the usual ship's steel. Ordinary wrought steel, galvanized iron, cast-iron and other materials have been used for cargo piping with similar results, the cast-iron being the most satisfactory due to its greater wall thickness. The theory has been advanced that the apparent inability of certain post-War steels to withstand corrosion is not due to any inherent defect in the steel itself, but principally to the presence of mill scale on the surfaces of the material. This theory is based on the fact that mill scale is intensely hard and much more impervious to corrosion than the steel it covers and therefore, as long as it adheres to the surface of the steel, the wastage of surfaces not so protected is intensified. This is not in accordance with our experience, and we have come to the conclusion that the reason for the relatively high rate of corrosion in way of brackets, framing, and other parts of the structure, where mill scale is not present, is largely the lessening of the corrosion-resistant qualities of the steel in those parts by punching, shearing, cold-working, and riveting of such structural members.

A great deal of money has been spent during the past ten years or so in an endeavor to produce an efficient protective coating for the interior of cargo tanks, and practically all of these compositions have been tested in our tankers and proven generally ineffective. It is doubtful whether any kind of protective coating is practical for the interior structure of the cargo tanks in the present-day ocean-going tanker, due to the virtual impossibility of getting all the parts properly cleaned and the subsequent difficulty of applying the protective coating in such a manner that there will be an effective film covering all surfaces without cracks or openings of any nature. Further tests for protective coatings are contemplated if the rust can be removed by an acid containing an inhibitor. It may be possible to reduce the rate of corrosion by the use of inert gases having the CO_2 content reduced to a minimum, thereby eliminating the pitting caused by carbonic acid gas. This will result in the inert gas consisting mainly of nitrogen. It is thought that if the ullage space in the tanks above the ballast water is effectively sealed with this inert gas the supply of oxygen to the ballast water will be cut off with the result that when the oxygen in the ballast water has been exhausted there will be a reduction in the rate of corrosion while the tank contains ballast water. Of course, the cost of such inert-gas equipment is very high and may be prohibitive.

TABLE II

Performance Comparison—American Coastwise. Period One Year

Deadweight	Speed L	Speed B	Fuel/day all purposes L	Fuel/day all purposes B	I.H.P. L	I.H.P. B	Aver. tons Cargo	Lbs. of fuel per 1,000 tons cargo mile
22,600 d.w.t. twin-screw triple-expansion, sat. steam	10.3	10.46	266 bbl. 41.33 tons	255 39.62	3,870	3,760	20,100	18.5 lb.
20,600 d.w.t. single-screw, high-pressure, superheated-steam, geared turbines	10.94	10.82	165.4 bbl. 25.7 tons	155.8 24.21	3,840 s.h.p.	3,815 s.h.p.	19,790	11.0 lb.
16,000 d.w.t. twin-screw, triple-expansion, sat. steam	10.19	10.21	227.4 bbl. 35.33 tons	222.8 34.62	3,047	2,971	15,365	20.44 lb.
15,150 d.w.t. single-screw, triple-expansion, exhaust turbine, mod. superheat steam	11.15	12.23	202.5 bbl. 31.47 tons	195.0 30.3	3,368	3,331	14,071	18.51 lb.
12,500 d.w.t. single-screw, quad. exp. sat. steam	10.09	10.31	168 bbl. 26.1 tons	167 25.95	2,585	2,467	11,770	20.47 lb.
11,000 d.w.t. single-screw triple-exp.	10.36	10.39	190 bbl. 29.52 tons	188 29.21	2,550	2,480	9,980	26.9 lb.
11,000 d.w.t. single-screw, geared-turbine, Scotch boilers, mod. superheat	11.13	10.85	199 bbl. 30.92 tons	192 29.83	.....	.....	9,378	27.51 lb.

About ten years ago, in order to determine, if possible, the actual rate of corrosion resulting from the transportation of various grades of cargo, the cargo-tank structures of several representative vessels were drilled and the thickness measured at one to two-year intervals, and on some vessels as many as 5,000 measurements were taken. As the result of these data we found that a vessel used exclusively for carrying bunker-fuel oils does not corrode at all due to the nature of the cargo carried. The average rate of corrosion in the vessels transporting sweet crudes is about one two-hundredths of an inch per year, while that in vessels carrying sour crudes is about half as much again or one-and-one-half two hundredths of an inch per year, due to the natures of the cargoes carried. These rates of corrosion are not great enough in themselves to shorten the vessel's useful life, the total corrosion amounting over a period of twenty years to not more than ten and fifteen percent of the original thickness of the affected structural members. Where corrosion becomes a truly serious problem is in those tankers used continuously for the transportation of clean cargoes, especially gasoline and kindred products. Our investigations have shown that the average wastage of tank structure in these vessels operated in the American coastwise service, amounts to almost one-sixteenth of an inch per year between the fourth and fifth years. Our investigation leads us to believe that very little corrosion takes place during the first year or so of a vessel's life and that during subsequent years the rate of corrosion is progressive, gradually increasing as the structure weakens, as we know, of course, that fatigue of metal accelerates corrosion and it is self-evident that the wastage increases as the structure weakens. As it weakens, the stresses in the structural members increase, the metal gradually fatigues and the rate of corrosion increases. In other words, it is a vicious circle of events which to date we have been unable to check.

Although the quality of steel found in pre-War built tankers indicates it to be better able to withstand corrosion than that in post-War built tankers, the fact remains that after the wastage of structural parts reaches a given point, the rate of corrosion for both kinds of vessel is practically the same. This is because in both cases the metal in the structure becomes fatigued due to weakening of that structure by wastage. In any case, the average 10,000-ton tanker continually employed in the Atlantic coastwise gasoline trade, could not lift more than 100 to 125 cargoes—which represents a period of six to eight years (Atlantic coastwise)—before renewal of structural plating would become essential. In the trans-atlantic service the period is increased to between twelve and fourteen years, due to the fact that in this service the alternations of sea-water ballast and cargo occur at less frequent intervals than in the coastwise trade. The rate of corrosion in tankers operated on the Pacific coast of the United States is not nearly as great as in those operated on the east coast. The reasons for this are two: One, that the west-coast vessel transports almost exclusively sweet crudes and products of such crudes, while on the east coast a large percentage of high-sulphur-content sour crude and the products of such crude are carried, and these latter are much more corrosive than the former; the other reason is that the tankers in the west-coast trade operate almost exclusively in sea water of moderately low temperature and in any case in sea water having a gradual change of temperature, whereas in the east-coast trade tankers operate for days in sea water having a temperature as high as 85 deg. F. and which is subject to extremely abrupt changes.

When we refer to a tanker corroding, we do not mean that the entire surface throughout the cargo-tank compartments corrodes at an equal rate. We refer only to certain parts in the cargo tanks, generally the extreme upper portion, and to a somewhat lesser extent the extreme lower part of the tank. The latter corrosion, however, is entirely different from the former. The upper structure wastes almost entirely over its surface due to the almost constant presence of petroleum gases in this part of the tank mixed with slight amounts of oxygen and the fumes from the practically stagnant sea-water ballast, these forming a highly corrosive gas. The extreme lower part of the tanks—in other words, the bottom plating—does not corrode evenly, but becomes

TABLE III

Performance Comparison—European Motor Tankers. Period One Year

Deadweight	Average Speed L	Average Speed B	Average Fuel/day all-purposes L	Average Fuel/day all-purposes B	Average I.H.P. L	Average I.H.P. B	Aver. tons cargo	Lb. of fuel per 1,000 ton cargo mile
18,000 d.w.t. twin-screw, airless-injection engines	11.22	11.58	135.42 bbl. 18.81 tons	133.14 18.49	5,081	5,000	16,528	9.15 lb.
18,000 d.w.t. twin-screw, air-injection engines	11.59	12.18	163.74 bbl. 22.74 tons	157.37 21.86	6,337	6,276	16,291	10.55 lb.
12,000-14,000 d.w.t. twin-screw, air-injection engines	10.00	10.66	96.05 bbl. 13.34 tons	92.69 12.87	3,752	3,722	11,934	9.72 lb.
13,500 d.w.t. single-screw, airless-injection engines	10.92	11.55	86.71 bbl. 12.04 tons	84.29 11.71	3,474	3,389	12,505	7.90 lb.

heavily pitted due to dilute sulphuric acid formed by the sweat from the tanks and the salt-water ballast mixing with the residue from the cargo always remaining in the tanks, and of hydrochloric acid set free from sea-water ballast. There are, of course, other conditions tending to induce the wastage of structural members, but with the exception of the corrosion due to fatigue these are of secondary importance.

That the main difficulty is caused by the necessity of using sea-water ballast augmented by having to operate our tankers in salt-laden atmosphere of relatively high-humidity is proven by the fact that the cargo-tank structures of gasoline-carrying vessels on the Great Lakes corrode so slowly that virtually no account is taken of such corrosion. It might also be mentioned that the vessels in our Baltimore fleet, operating in Chesapeake Bay and tributary waters, show very little structural wastage, which is undoubtedly due to these boats using fresh water or nearly fresh water and in some cases no ballast at all, and operating a good deal of the time in inland waters where the atmosphere is not as salt-laden as over the ocean.

In mentioning the relatively small amount of corrosion in crude-oil carriers, the rate of corrosion due to the nature of the cargoes was stipulated. This was because there is another form of corrosion which particularly affects the larger vessels, that is, the corrosion caused by fatigue of the steel structure. All tankers have a more or less pronounced undulating motion or "whipping" at sea and, as a rule, the larger the tanker the greater this whipping. The steel of the tanks in way of this so-called whipping is subjected to unusual stresses and the metal gradually becomes fatigued and less and less able to withstand corrosive action of petroleum cargoes and sea-water ballast. The effect is cumulative and the more fatigued the metal becomes the more rapid the corrosion and the more rapid the corrosion the sooner the metal reaches the breaking point and cracks show up in the plating. It is, of course, true that some corrosion takes place on the bottom of all these tankers due to the presence of sludge in the tanks during the ballast voyages, but the tanks in way of the greater whipping movement show far more pronounced corrosion: in other words, tanks Nos. 5, 6 and 7 and in some cases No. 8 of the larger tankers. It seems logical to assume, therefore, that the major corrosion is due to fatigue of metal though this is not the general opinion held regarding this point, most experts believing that the fatigue follows the result of excessive corrosion. However, our observations lead us to believe that in the case of tanker corrosion there occurs a repeated cycle of fatigue-corrosion-fatigue and a further substantiation of our opinion is to be found in the smaller tankers where the pronounced corrosion is evidenced only in Nos. 7 or 8 tanks, these again being the tanks in which occur the greatest reversals of stresses due to whipping and the change from ballast to loaded conditions. The maximum rates of corrosion mentioned refer, generally speaking, to the structure in the tanks normally used for the carrying ballast as the structure of these tanks has been found to corrode more rapidly than in those not generally used for this purpose. For this reason it is necessary carefully to observe and analyse the conditions of corrosion and fatigue that may occur in the tank body of the vessel and by improvements and repair of the structure maintain as far as is practicable the requisite strength of the tank structure.

Question of Speed

WITH the adoption of the Diesel engine for the propulsion of tankers, there has been a tendency toward higher speeds, this condition being brought about by lower fuel cost for an increase of speed and also under some conditions the extra carrying capacity in the case of motor tankers, as compared with steam tankers. The tanker with respect to speed is in a somewhat different category from the ordinary cargo vessel in general trade, inasmuch as high-speed general cargo vessels may in normal times command a relatively higher freight rate for the carriage of the more valuable or perishable general cargoes, leaving the general bulk commodities to be transported at a lower freight rate by slower vessels. In the case of a tanker voyage freight rates are little influenced by the speed of the vessel, or for that matter to any great extent by the different nature of petroleum products carried in bulk, although there is usually a somewhat higher freight rate in the case of high-test gasoline and lubricating oil cargoes which require specially constructed vessels and equipment. The corrosion in cargo tanks arising from the carriage of clean products necessitates costly structural repairs which in turn must be reflected in the cost of transportation of these products. In normal times, when freight rates are good, the higher-speed motor tankers can make extra voyages per year in proportion to their excess speed over that of the normal steam tanker. When freight rates are low the excess speed is an incumbrance in the sense that the higher powered machinery represents an increased capital outlay, which is reflected by the higher fixed charges when compared with slower speed vessels.

There are two phases of the speed problem, one being to attain the minimum cost of transportation per barrel of cargo, the other being the maximum revenue which the tanker can earn during a prescribed period, this maximum revenue involving another variable, that is the profit differential which does not enter into the question of speed when considering the net cost of transportation per barrel. With a higher speed it is possible to make more voyages in a prescribed period when freight rates are higher than the net cost of transportation. In the case of higher speeds the first cost of the vessel is higher, and its deadweight capacity less, due to finer body lines. Due to the reduced time for a given passage at higher speeds, there may be a reduction in the total charges for insurance, interest, depreciation, overhead, wages, provisions, stores, etc., although the per diem rate for some of these items may be higher than in the case of a slower-speed vessel. The problem, therefore, is to balance the items of cost against the increased revenue in a given period at higher speeds; if there is not a profit differential between the net cost of transportation and the freight rate, then there is no reason for higher speeds, indicating that speed increase varies directly with the differential of profit between the net transportation cost and the freight rate; that is the difference between cost of the service and the value of such services in the open market.

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Telescopic Taps

DIFFICULTIES that have hitherto prevented supplies of Phillips Telescopic Taps for oil drums from being supplied in the United States on an economical basis, have been overcome and this ingenius device is now available to manufacturers in the United States as well as in England and Europe.

The tap consists of a tube built into the oil drum at the time the drum is manufactured. Inside this tube is the tap, which when closed is flush with the surface of the drum thus eliminating the possibility of breaking off. By drawing the inside tap out the oil may be made to flow when the tap is fully extended. To shut off the flow, the tap is merely shoved back into place checking the flow by a sleeve valve. The purpose of the tap is to prevent the necessity of removing bungs and inserting faucets or alternatively, of tipping heavy containers with attendant spilling and wasting of the contents and the creation of a considerable fire hazard.

Tanker's Place in U. S. Shipping Program

Needs of American Navy May Bring About Construction of Faster Tankships—Present Tanker Fleet Rapidly Becoming Obsolescent.

OBSOLESCENCE is the problem of American tankship owners. Its proportions are indicated by the fact that of 348 vessels (over 2,000 tons) of this class under United States registry only 29 were constructed during the past ten years. Over 70 percent of the present fleet was built in the five-year period 1916–21. Estimating twenty years as the extreme figure for the normal life of a tanker it is evident that from 1936 on rapid replacement of obsolete ships will be necessary.

The oil companies who are the owners of the major part of this tanker fleet are not unaware of the situation. Nearly every large company engaged in marine transportation has in its engineering department plans and estimates for a more or less extensive program of construction. Some of these plans have been brought out at intervals during the past two or three years for the consideration of boards of directors or executive committees but in nearly all cases the decision has been postponement. Meanwhile costs have advanced and certain oil company officials now regret that they did not act earlier when a very substantial saving could have been effected.

Two factors have combined to delay action. One has been the financial situation. Companies that were losing money on their current operations naturally were not keen to invest millions of dollars in new facilities. Another reason was the uncertain outlook. For the past two years there have been promises of a new shipping program at Washington but no action has been taken in that direction. President Roosevelt has now made a definite declaration of policy in favor of direct as against indirect subsidies and a bill regulating government assistance to shipping is before the Congress.

At least one department of the national government has a direct interest in the rejuvenation of the tanker fleet. Officials of the United States Navy are painfully aware of the out-of-dateness of American tankers. Operations of naval ships are dependent upon their fuel supply. The range and efficiency of a fleet's movements are regulated by the speed of its slowest members. The slowest members of an American fleet today would be its tankers as there are only eight tankships of U. S. registry rated at or above 12 knots. If the American navy were called upon to engage in a major operation the lack of efficient fuel carriers would be a great and serious handicap.

Naval officials would like to have available in the United States a number of tankers capable of a sustained speed of 18 knots. Such speed adds heavily to construction costs and likewise increases operating expense. To a limited extent the latter is offset by the larger number of trips the fast tanker can make. Some architects and engineers hold that boats can be built to make 14 or 15 knots without any sacrifice of economical operation, but purely commercial considerations do not justify going beyond that and even at that figure the extra cost of construction could not be covered by the tanker's earnings.

From the viewpoint of national defense there are two possible courses that may be followed. One is for the government itself to build tankers of the necessary speed and cruising range as an integral part of its naval equipment. The other is to encourage the building by private companies of tankers meeting the requirements of the Navy and subject to requisition in time of need. This would involve a government subvention to cover the extra cost imposed by the provision of speed above ordinary commercial needs and a contribution toward operating costs.

For numerous reasons a subsidy appears the more advantageous policy. For the same expenditure it would make available a much larger tonnage. The greater part of the building and operating cost would be borne by the private owners, whereas, if the government builds for its own exclusive use, it must bear the entire cost. When the Navy is on ordinary peace time service its fuel requirements can be met by a relatively small number of tankers but if called upon to engage in a major operation a much greater number would be needed. Adequate preparedness through government construction would dictate the building of sufficient tonnage to meet any emergency. A considerable portion of it probably would be laid up most of the time but ships that are laid up deteriorate more rapidly than those that are kept continuously in good operating condition.

The bill now before Congress for development of the merchant marine along the lines suggested by the President would establish a special board of five members to be known as the United States Maritime Authority. The board would be authorized to grant to builders of new tonnage determined to be necessary in accordance with provisions of the law a subsidy sufficient to cover the difference in cost of construction in American and foreign yards. Upon completion of the vessel the board could enter into an agreement to pay an operating subsidy equal to the difference in operating costs under the American and other flags.

Plans for such vessels would be subject to approval by the Navy Department which could suggest such changes as might be necessary to make them available to use as naval or military auxiliaries. If such changes involved increased construction or operating costs an additional payment sufficient to cover these extra costs could be granted. The board would be empowered also to purchase and scrap vessels deemed obsolete and to apply the proceeds toward the owner's share in the construction of new vessels.

Because of the nearby expiration of existing ocean mail contracts and the desire to renew these on a different basis the federal administration is anxious to have legislation at the present session of Congress. Whether this will be possible remains to be seen but a strong effort to put through the pending bill or one embodying its main provisions undoubtedly will be made. If successful an early resumption of marine construction will take place in American shipyards.

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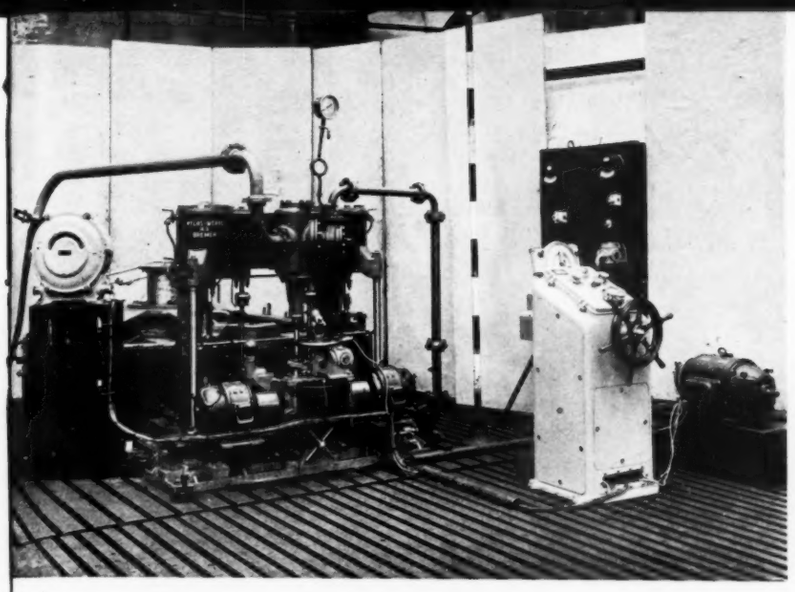
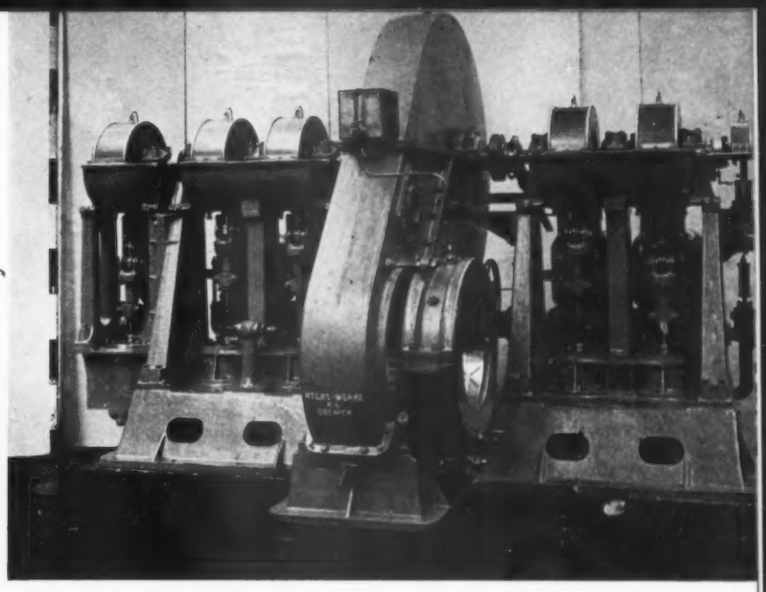
OUR FRONT cover picture this month shows the new tanker, Rotula, recently completed by the Netherlands Shipbuilding Co. for the Royal Dutch-Shell Group. Propelled by Workspoor 4-cycle Diesel engines developing 4,000 s.h.p. at 120 r.p.m. she attained a speed of over 13 knots on trial.



Atlas steam steering gear with electric remote control of the A.E.G. type, and Anschütz automatic steering column.



Atlas pump group for cooling water. The three large cylinders are built for an output of 60 tons/hour. The small pump at the right is the feed pump for the exhaust-gas boiler.

Simplifying Tankship Operation

Careful Selection of Modern Auxiliary Equipment Simplifies Tanker Navigation and Removes Element of Chance. Great Improvement in Instruments.

By R. Blaum

Director
Atlas-Werke

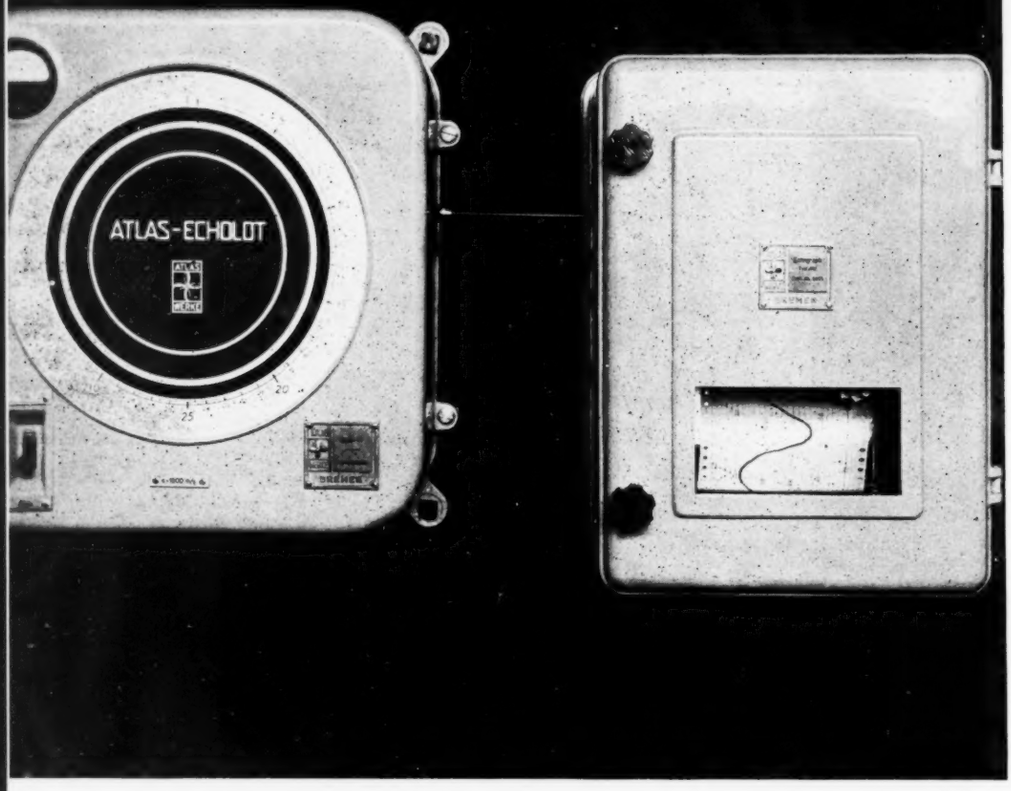
THE TRANSPORTATION of oil overseas, in order to satisfy the demands of countries having no oil resources of their own, requires increased reliability and economy on the part of the oil carrying ships. Accordingly all tankship owners aim at reducing the layed-up time in port as far as possible and to utilize the capital invested in the fleet to the greatest extent, as well as to cover the requirements of the customers with the smallest possible number of ships. Hence, the sea journey must be safe and undisturbed, and discharging of cargo must be effected quickly and without trouble.

In insuring the proper fulfilment of these requirements the auxiliaries play an important part.

On tankers one must distinguish between the auxiliaries serving exclusively for navigation purposes and the special appliances for discharging, loading and cleaning the vessels. It is from these angles that the problem of which type of construction is most appropriate can be best resolved.

During the last fifteen years motor ships have become increasingly popular, particularly for tankers. However, besides the motors for the main engine every tanker requires a correspondingly powerful boiler plant for driving the cargo-oil pumps, a plant which must not only produce the steam for loading and discharging, in port, but also at sea for the filling and emptying of the tanks when running in ballast, and for cleaning the tanks. In addition, waste-gas boilers have been used with good success during the past ten years.

With this arrangement the question arises, whether it is best to drive the auxiliaries electrically, as is otherwise the case on motorships, or by steam. In the interests of economical service and low construction costs the advantages of a high degree of steam drive, whereby such large tanker operators as the Standard Shipping Company have connected waste-gas boilers with oil-fired boilers, has been widely recognized. Only enough electricity is generated on board as is necessary for lighting and sanitary purposes (driving the refrigerating machine). The steam drive of the other auxiliaries, curious as this may appear on a motorship, in the present case presents many advantages. Even with steam produced exclusively by waste-gas boilers, sufficient steam will always be available at sea to drive the ship's dynamos and the steering gear, as well as to supply adequate heating for the crews' quarters. By coupling the waste-gas boiler with the oil-fired donkey boilers, any suddenly increased demand for steam can be automatically covered. The winches, of which there are only a limited number on board, are not used for taking over the ship's cargo but for manipulating the piping, and the windlasses are only used when the vessel approaches port, and when the oil-heated boilers must be used for working the cargo-oil pumps, as well as for warming the oil. From this point of view also steam-driven winches and windlasses for tankers will be most economical. Eliminating a large number of motors for individual auxiliaries, with the requisite switches, etc., facilitates the service to the crew—a particularly important point, as high demands are put on the personnel



Atlas echo sounder combined with Atlas Echograph.

during the many sea-days. The simplification of the electric wiring on ships carrying inflammable cargo is likewise very desirable.

Next to the customary constructional types of ships' pumps for the requirements of the engine room and the crew's accommodation a number of special types have been developed to answer these demands in an economical manner.

For some time opinions differed as to the suitability of steam or electric power for the steering gear. Apart from the above mentioned reasons, steam drive has the advantage for the tanker, that the engine plant lies in the after body of the ship, and therefore only short steam pipes need be laid from the boiler to the steering gear. On the other hand the long distance between the bridge and the steering-engine compartment requires very long telemotor lines to the steering gear. Steering columns do not come into question at all for large ships, as in consequence of the elasticity of the ship's body they are too difficult to move. However, the long telemotor line—particularly when it must be laid in the open—has various disadvantages; also some damage to the lines of piping laid on the running bridge should be anticipated. It, therefore, appeared to be best in the first place to use purely electrically-driven steering gears, which, in combination with the "A.E.G." system of electric remote control from the bridge (Sympathetic Control), has given first-class service. This system, however, required increased output from the dynamo. When electrical control of the steam steering gear was successfully accomplished, with or without automatic steering from the bridge, it was deemed desirable to return to steam drive. An illustration of such a steering gear is shown in an accompanying picture. In this system the change valve is actuated by a small motor, controlled by a Leonard group; the automatic control gear is of similar construction to those employed in steam steering gears. The engine can run with or without self-steerer. There is also the full reserve for the steering motor of the change valve. The plants have proved very satisfactory.

Also the hydraulic gear with two rams with steam drive, recently introduced for the hydraulic pump, has proved satisfactory.

When there are no special capstans on board, the windlasses are used for warping the ship. They must, therefore, be able to haul in the loose rope quickly. For tankers steam windlasses are built with a special intermediate gear, which is used for warping. At high speeds of the warping end, which sits on the main shaft, the pull of the hawser is still very substantial, so that special warping capstans can be dispensed with. Having regard to the very exposed position of the capstan on tankers, the simplification of the deck machinery is desirable.

A number of cooling water pumps (piston cooling water, cylinder cooling water, seawater for recooling, etc.) are necessary for the main motors. These pumps only work as long as the main motor runs, and they have only to serve its wants. In order to eliminate a special drive for these pumps a special pump group has been developed, which is driven from the propeller shaft, by a noiseless chain. Ample air chambers both on the suction and the pressure sides are a condition for perfect working. Large overflow valves between suction and pressure main must protect the pump from destruction in consequence of mistakes in the connections. The pump can be switched out during the running of the engine, into single groups, so that after switching in the steam-driven reserve pumps repairs can be carried out at sea when the main motor is running. The feed pump for the waste-gas boiler can be connected with the pump group.

The other auxiliaries, such as all reserve pumps, are steam-driven horizontal or vertical simplex or duplex pumps, which only enter into service when trouble arises in the pump group. A large steam-engine with reserve compressor, but which can only work in conjunction with the existing oil-fired boilers, should likewise be carried on board. A small reserve compressor can be coupled with a steam-engine intended for continuous service at sea.

The most important machine for loading is the cargo-oil pump. Its perfect working makes only a short stay in port necessary. It must be of such strong and simple construction that the personnel has but little maintenance work. Economic steam consumption can be attained by a combined switch arrangement on the steam side. The accompanying illustrations show compound pumps and common duplex pumps of various sizes. The construction of the valves is of particular importance. Many years' extensive experiments were necessary to find a valve suitable under all conditions. It was first thought that with heavy oils, heavy valves were necessary, and with light oils, light valves. Experience proved, however, that the heavy valves broke quicker and gave rise to difficulties. A large variety of materials were tried and failed. Nowadays the valve such as is shown in an accompanying illustration, is used. It ensures a noiseless run of the pump, efficient operation because the valves always close, and little wear and tear. Valves,

liners and pistons (particularly the valves) must be readily accessible.

Either single valve chests are built which on removal of the cover permit the extraction of a set of suction and pressure valves, with seats, without further difficulty, or large hand holds and a common valve plate are provided for the lower valve seat. Both constructions have proved satisfactory, provided that due consideration has been paid to a good lead through the valves and slow speed in the valves. Next to the valves, properly arranged suction and pressure air chambers play an important rôle in the smooth working of the pumps. Pounding in the pipes and the destruction of the latter resulting therefrom are avoided if very large suction and delivery air chambers are arranged in the vicinity of the pump. Particular attention is called to the importance of the suction air chambers.

Among the other pumps mention must be made of those of the Butterworth system, for cleaning the ships. Comparatively high pressures must be produced for this purpose. The hot water must be conducted to the nozzles in a uniform jet. This stipulates the employment of not too slowly running duplex pumps, the valve chests and valve sections of which, however, must be of ample dimensions, to prevent washing out and cavitations.

To fulfil their purpose tankers must be equipped with the very best navigational auxiliaries, as these ships frequently have to enter harbours with difficult approaches. Besides the radio direction finder these include of late the echo sounder. Since it has become possible with the Atlas Magnetrostriction Sounder to measure depths from ½ metre under the keel with running indication, and also graphically to record them, this sounder has become of particular importance for tankers. The installation of the sounder increases safety in a high degree and enables the captain, in thick weather, to overcome difficult harbour entrances with safety and without loss of time, thus considerably increasing the economy of the ships equipped with this apparatus.

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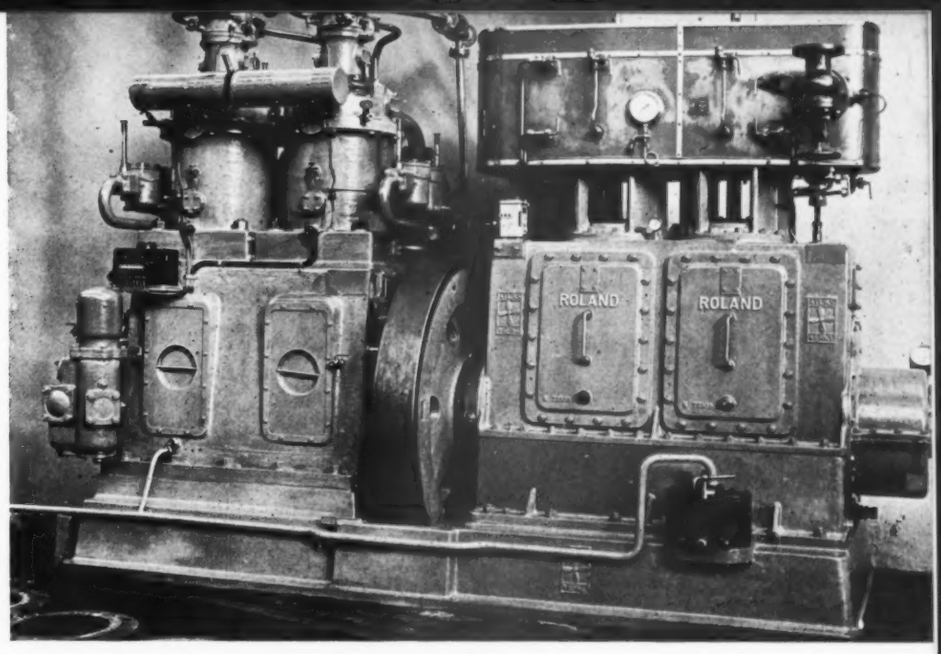
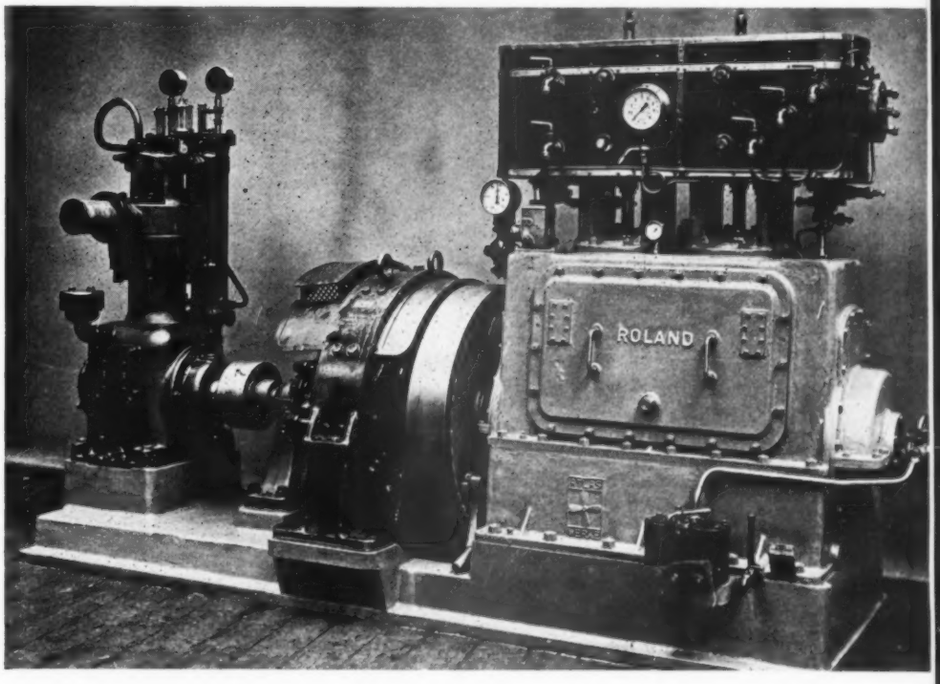
FOUR important American oil companies, Jersey Standard, Humble, Sun and Tidewater, have announced wage increases of five percent since the decision of the Supreme Court finding the N.I.R.A. unconstitutional. In the case of operating subsidiaries of Standard Oil Co. (N. J.) this increase affects 46,700 employees earning $5,000 a year or less and results in an increase in domestic payrolls of $4,000,000 yearly.

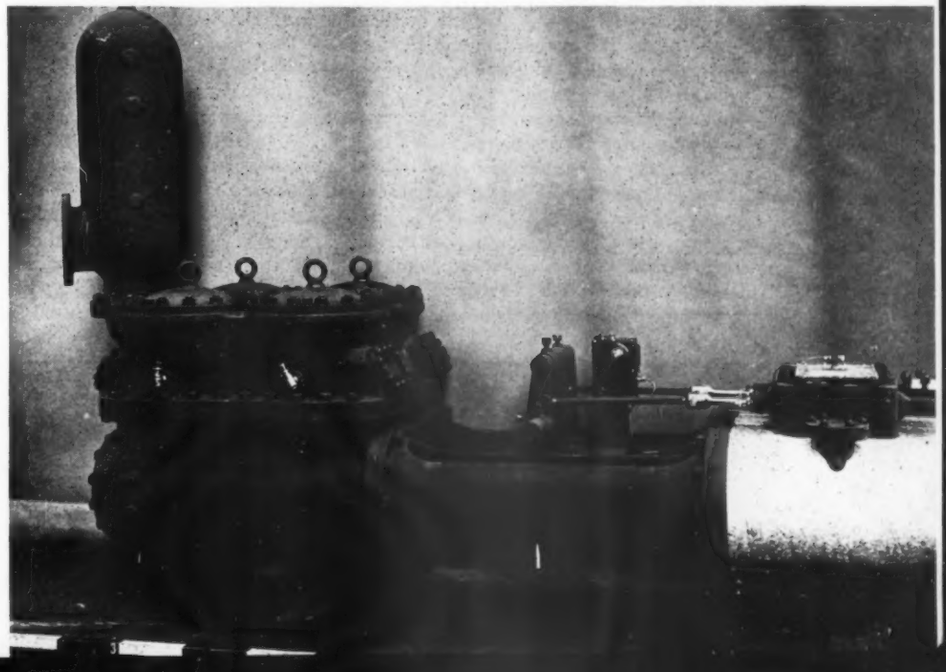


Atals reserve steam compressor with steam-engine.

Dynamo for electric lighting and emergency compressor connected by a disengageable clutch.



Atlas duplex cargo-oil pump for 200 cubm/h. Hand holes for overhauling valves are shown to the right of the pump cylinder.



Japanese Tankers Set New Speed Record

Diesel Powered Toa Maru Exceeds Nineteen Knots on Trial Trip—Other New Tankships Building. High Speed Tankers Useful Auxiliaries for Fleet.

FOR SEVERAL years Japan has led other nations in the matter of fast tankers. Four years ago she brought out the TEIYO MARU which developed a speed of 17½ knots and during the past year her commercial tanker fleet has been augmented by the construction of two motor ships said by their builder to be the fastest in the world. One of them exceeds the former record holder by a half knot and the other by a full knot per hour.

These tankers are the M.S. KYOKUTO (Far Eastern) MARU and the M.S. TOA (Eastern Asia) MARU, built for the Iino Shoji Kaisha by the Kawasaki Ship Yard, Kawasaki, Japan. Iino Shoji Kaisha also own the M.S. FUJISAN MARU, built several years ago, and conduct a tri-route transportation line in the importation of crude oil to Japan. In addition to shipments on their own account they accept offers for trip charters on their three tankers. The KYOKUTO MARU was recently taken on trip charter by Mitsui & Company to transport 10,000 tons of crude from Los Angeles to Japan.

The regular routes covered by this trio of tankers include: (1) Oxa, Sakhalin to Yokohama and Kobe; (2) Los Angeles to Yokohama and Kobe, and (3) Tarakan, Dutch East Indies to Kobe and Yokohama.

Powered by eight cylinder Diesel engines, the new tankers on the Trans-Pacific and Dutch East India routes develop 8,000 h.p. with a cruising speed sufficient to enable them to serve as fuel carriers to the Japanese Navy in event of emergency. While the first line fighting ships are capable of speed considerably in excess of the maximum possible by the tankers, a cruising speed of 18 knots is ample for all but an extreme emergency.

While the new tankers are conventional in appearance so far as bridge, officers quarters and after house are concerned it will be noted that they are clipper bowed, after the manner of modern passenger carriers, enabling them to ride dry except in very heavy weather.

While the speed rating of TOA MARU is 18.5 knots it is stated that on her trial trip she developed a speed of 19.1 which is a remarkable performance for a vessel of her power and dimensions.

In their general arrangement these ships are of conventional tanker design, oil cargo tanks occupying the amidships portion of the hull with the machinery aft and a dry hold forward. For convenience in carrying both light and heavy oils the tanks are separated into forward and aft groups. Two continuous bulkheads reaching to the level of the upper deck extend the full length of the tank section. There are also two tanks for gasoline, one on each side of the forward section of the ship.

Dimensions of New Japanese Motor Tankers

	M.S. Kyokuto Maru	M.S. Toa Maru
Length b.p.	510.81 feet	500 feet
Width	65.51 "	65 "
Depth	37.38 "	37 "
Draught at full cargo	26. "	29.83 feet
Gross (D/W)	13,500 tons	13,500 tons
Net	10,000 "	10,010 "
Speed	18 knots	18.5 knots
Engines—Diesel	8 cyl. 8,000 H.P.	8 cyl. 8,000 H.P.
Lloyds rating	100-A-1 L.M.C.	100-A-1 L.M.C.
Cargo capacity	12,000 tons	12,000 tons

Propulsive power is provided by a double acting two-cycle, eight cylinder airless-injection Diesel engine of the Kawasaki-M.A.N. type. The engine has a normal output of 8,000 h.p. at 110 r.p.m. and on her trial trip the TOA MARU developed 8,591 h.p. Three generators installed in the engine room are driven by Kawasaki-M.A.N. four-cylinder, single-acting, seven-cylinder Diesel engines developing 445 h.p. at 375 r.p.m. There is also an emergency Diesel-engined dynamo, developing 40 h.p. at 450 r.p.m.

To provide the steam used for heating the oil tanks, driving the cargo pumps and other general purposes two boilers with a heating surface of 252 square metres and one exhaust gas boiler with a heating surface of 334 square metres are located in the boiler room.

Other auxiliary boiler room machinery consists of two centrifugal sea-water pumps with a capacity of 530 cubic metres per hour at 30 metres head, two fuel oil transfer pumps, two fuel oil service pumps, a cooling-water pump and a fire pump with a capacity of 20 cubic metres per hour at 35 metres head.

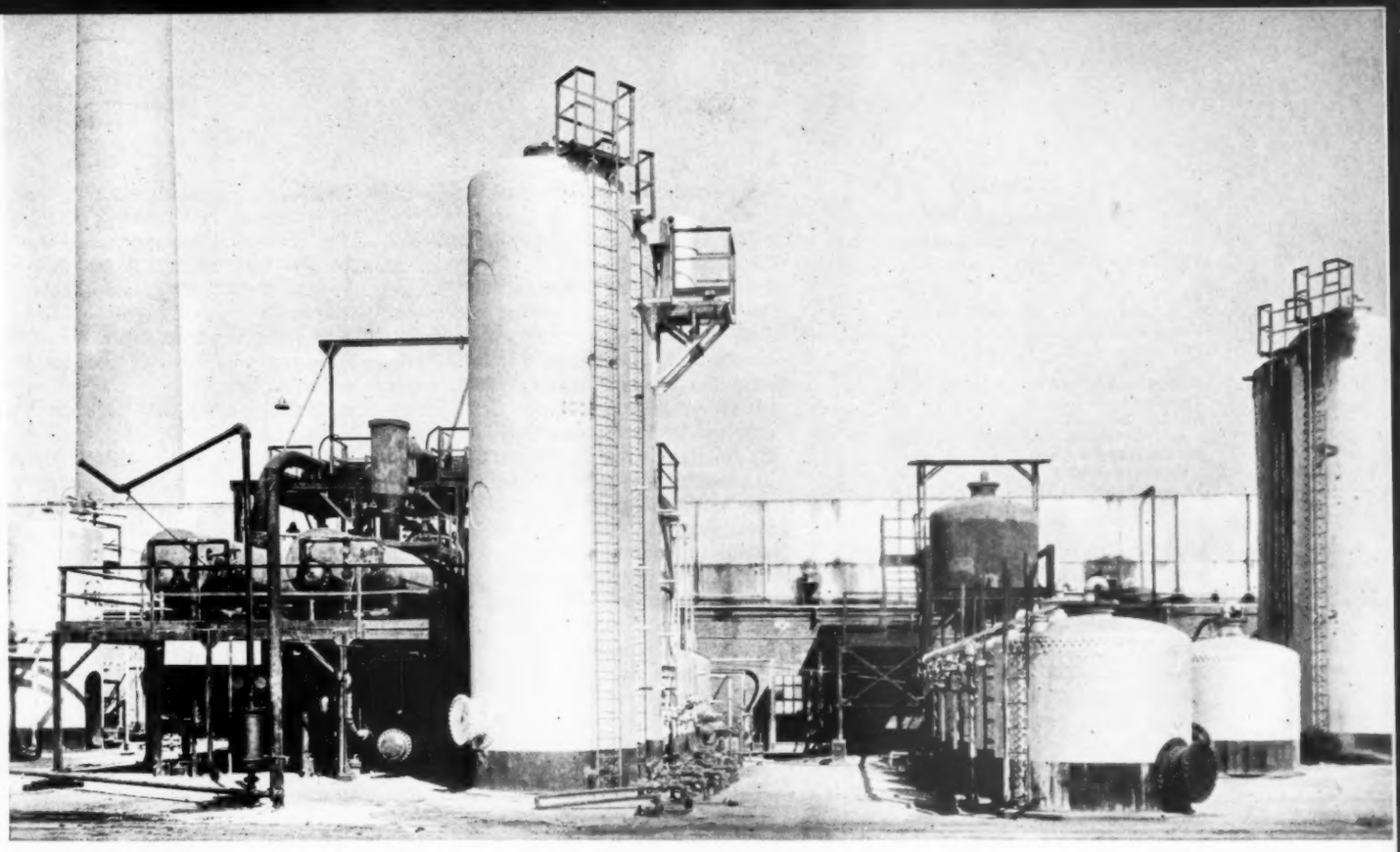
A fresh water cooling system is provided, oil being mixed with the water to prevent rust. Two sets of electrically driven centrifugal pumps are installed. Each has a capacity of 530 cubic metres per hour at a head of 30 metres. Each is driven by a 95 h.p., 220-volt motor at 1,150 to 1,300 r.p.m.

There are two rotary gear type lubricating oil pumps with a capacity of 75 cubic metres per hour at 50 metres head. Each is driven by a 40 h.p. electric motor at 1,000 r.p.m.

Each tanker is equipped with special fire fighting devices and with a flue gas fire prevention system. Cooled and washed flue gas is led to each oil carrying compartment through branches on the upper deck. Steam is employed for fighting fire in the holds while a fire pump of 20 cubic metres capacity is provided for use elsewhere.

To insure rapid discharge of cargo each tanker is equipped with four high pressure booster pumps, each with a capacity of 300 tons (2,100 bbl.) per hour.

In addition to the vessels above described a new 11,000-ton, deadwright, tanker to be called the SAN RAMON MARU is under erection at the Mitsubishi ship yards, Nagasaki. She is 445 ft. in length over all, 57 ft. moulded breadth and 35½ ft. moulded depth with a registered speed of 14½ knots. Her motive power consists of a 2-cycle single acting 5-cylinder airless injection type Mitsubishi 3,300 b.h.p. engine with two auxiliary 4-cycle single acting airless injection type Mitsubishi Diesels of 105 b.h.p. She will be added to the fleet of tankers operated by Mitsubishi Shoji Kaisha Ltd. which already includes the SAN DIEGO MARU, SAN LUIS OBISPO MARU and SAN PEDRO MARU all of which are engaged in transporting crude oil from California to Japan.



Mid-Continent Petroleum Company's Chlorex plant at Tulsa, Oklahoma.

Selective Solvent Extraction With Chlorex

Seven Commercial Plants Now in Operation Described and Results Achieved With Other Types of Charging Stocks Given in A.P.I. Paper Delivered at Tulsa

By D. B. Williams

Carbide and Carbon Chemicals Corp.

THERE are now seven commercial Chlorex plants operating, with a combined charging capacity in excess of 6,000 bbl. of oil per day. Figure I is a list of these plants with the daily charging capacity of each. The Freedom and Bradford Penn installations were recently placed in operation. The other five have been running for some time, and have treated a total of something like 60,000,000 gal. of oil.

The plant operated by Standard at Casper, Wyo., is treating overhead stocks from Salt Creek crude. The units at Wood River, Ill., and Tulsa, Okla., are treating oils from Mid Continent crude. The other four plants were installed during the past 12 months for refining Pennsylvania oils.

The Pennzoil Company placed their Chlorex plant in operation last June. This plant has treated neutrals, bright stock, and 600-flash steam-refined cylinder stock with uniformly good results. In the treatment of cylinder stock and neutrals by The Pennzoil Company, raffinate yields of 90 percent to 92 percent, or better, have been secured. They have enjoyed a very considerable improvement in filter yields when finishing cylinder-stock raffinates to bright-stock color specifications. No difficulties have been encountered in dewaxing the wax-bearing raffinate; in fact, they have removed a drier petrolatum stock in the plant centrifuges, using the same chilling temperature and naphtha dilution as formerly on filtered cylinder stock. It is necessary to use a

FIGURE I

Commercial Chlorex Plants in Operation

Plant	Daily oil-charging capacity (42-gallon barrels)
Standard Oil Company (Indiana), Casper, Wyo.	600
Standard Oil Company (Indiana), Wood River, Ill.	1,000
Mid Continent Petroleum Corporation, Tulsa, Okla.	200
The Pennzoil Company, Oil City, Pa.	1,000
Socony-Vacuum Oil Company, Inc., Olean, N. Y.	1,700
Freedom Oil Works Company, Freedom, Pa.	1,200
Bradford Penn Refining Corporation, Clarendon, Pa.	450
Total	6,150

TABLE 1

Data on Pennsylvania Neutral

	Original	Raffinate	Extract
Yield, percent by volume	100.0	92.1	7.9
Gravity, deg. API	30.1	31.5	15.3
Flash point, deg. F.	425	425	...
Fire point, deg. F.	500	500	...
Pour point, deg. F.	20	25	...
Color, NPA	3.5	2.5	...
Carbon residue, percent	0.03	0.01	...
Sligh oxidation No.	28.4	3.4	...
Saybolt Universal viscosity at 100 deg. F.	179	168	927
Saybolt Universal viscosity at 210 deg. F.	45.8	45.6	62.5
Viscosity index	109.1	117.5	—12.1

slightly higher water temperature on the centrifuge bowls to facilitate removal of the higher-melting-point wax.

The extraction equipment at Pennzoil is a 3-stage counter-current system of mixers and settlers. Mixing is accomplished by orifice-plate pipe mixers. These have proved very efficient as a means of contacting the solvent and oil. Chlorex is now recovered from the extract and raffinate solutions in a pipe still incorporating a vacuum stripper.

The Chlorex plant operated by the Socony-Vacuum Oil Company, Inc., at Olean, N. Y., has a charging capacity of 1,700 bbl. per day. This unit has operated continuously since early last August. The extraction equipment consists of a 4-stage counter-current system of settling tanks and mixers. Chlorex is recovered from the raffinate and extract solutions in shell stills which are designed for, and maintained under, a vacuum of 26 in. mercury. Heat for distillation is supplied with closed steam coils using 140-lb. live steam. Each still is also provided with open steam coils to facilitate the stripping operation. Two 400-bbl. stills are used for recovering the solvent from the raffinate solution, and four of the same capacity for the extract solution.

In both the Pennzoil and Socony-Vacuum plants considerable equipment which was available in the refinery, including the distillation equipment in both cases, was utilized in construction. The installations for the Freedom Oil Works Company and the Bradford Penn Refining Corporation are new from the ground up.

The Freedom unit has a charging capacity of 500 bbl. per day of 600 steam-refined cylinder stock or up to 1,200 bbl. per day of neutral. The solvent is recovered from the extract and raffinate solutions continuously in separate steam-heated stripping columns maintained under a vacuum of 28 in. mercury. Complete removal of the solvent is effected at a maximum stripping temperature of 300 deg. F. In the Bradford Penn Chlorex plant, heat for distillation under a vacuum at 26–28 in. mercury is applied by means of a hot-oil circulating system. The Bradford Penn plant has a capacity of 300 bbl. per day of cylinder stock or 450 bbl. of neutral.

Typical results on a 180 neutral from Pennsylvania crude are shown in Table 1. This distillate was treated with Chlorex in 7-stage continuous counter-current apparatus with a ½-to-1 ratio of Chlorex to oil by volume at a temperature of 65 deg. F.

A 92.1-percent yield of oil was obtained, which shows an improvement in viscosity index from 109.1 to 117.5. Increased oxidation resistance is indicated by the reduction in Sligh No., although some feel that this test is more qualitative than quantitative. The laboratory where this extraction was conducted is not yet equipped to run the Indiana oxidation test, which many consider gives a better index of oxidation resistance of an oil than the Sligh test does. The viscosity index of this neutral was increased to 121.2 in another extraction, using the same number of counter-current stages, a higher Chlorex-to-oil ratio (1 to 1), and a higher temperature, 80 deg. F. Under these conditions, improvement in the oxidation resistance, as measured by the Sligh No., was the same. Raffinate yield was slightly lower.

In considering solvent extraction as applied to Pennsylvania oils, refiners in that region are interested principally in the treatment of steam-refined cylinder stock. By four-stage counter-current treatment of a typical 600 stock, results shown in Table 2 were obtained. The oil was treated at a temperature of 75 deg. F. using a 1.5-to-1 Chlorex-to-oil ratio, by volume.

It will be noted that the extract loss on this stock was only seven percent. The extract has a gravity of 10.9 (nearly the same as that of water), a viscosity of 1,445 sec. at 210 deg. F., and a viscosity index of approximately −30. The character of this extract clearly demonstrates the high selectivity of the solvent. By treating this stock with Clorex, a 93.0-percent yield of wax-bearing raffinate was obtained, with a reduction in the Conradson carbon residue from 2.07 percent to 1.40 percent. When the original stock and raffinate were dewaxed to pour points of +25 and +20 deg. F., respectively, and both oils were filtered to an 8 NPA color, it will be noted that the treated bright stock had a carbon residue of 0.91 percent as compared with 1.44 percent on the conventionally-refined bright stock. At the same time, the percolation yield was increased from 446 gal. per ton to 562 gal. per ton, which represents a considerable saving in filter costs for the same bright-stock color. A comparison of the percolation yields when finishing the dewaxed charging stock and the dewaxed raffinate to various NPA colors will be found in Table 3.

The increased demand for lighter lubricating oils has placed a premium on neutrals. Pennsylvania neutrals are selling for around 28 cents a gallon, while the price of bright stock has dropped to around 16 cents a gallon. This situation is just about the reverse of what it was a year or so ago. When treating a Pennsylvania

TABLE 2

Data on Pennsylvania Steam-refined Cylinder Stock

	Original Charging Stock			Raffinate			Extract from Original
	Wax-bearing	Dewaxed	Finished	Wax-bearing	Dewaxed	Finished	
Yield, percent volume	100	...	...	93.0	...	...	7.00
Gravity, deg. API	26.9	26.6	27.2	28.1	27.8	28.2	10.9
Flash point, deg. F.	590	585	585	585	580	580	...
Pour point, deg. F.	50	30	25	55	25	20	...
Carbon residue, percent	2.07	1.90	1.44	1.40	1.33	0.91	...
Color, true	1,500	1,700	333	1,100	1,190	260	...
Color, N.P.A.	...	...	8	...	...	8	...
Acidity	0.56	0.12	0.10	0.39	0.07	0.06	...
*Viscosity at 210 deg. F.	161.2	173	159.9	150.9	161.8	152.4	1,445
*Viscosity at 130 deg. F.	887	...	...	784	...	...	...
*Viscosity at 100 deg. F.	2,231	2,695	2,338	1,908	2,272	2,083	...
Viscosity index	109	104.5	105.5	112.0	108.3	108.5	—30 approximate
Viscosity-gravity constant	0.804	0.805	0.802	0.796	0.797	0.795	0.907

* Kinematic viscosity converted to Saybolt seconds by means of A.S.T.M. equations.

TABLE 3

Percolation Yields

Stock	Color (NPA)	Percolation Yield (Gallons of Viscous Oil Per Ton of No. 1 Attapulgus Clay)
Original	6	376
	7	392
	8	446
Raffinate	6	467
	7	490
	8	562

steam-refined cylinder stock with Chlorex a reduction in the viscosity at 210 deg. F. of from 10 to 12 sec. is obtained.

This offers two advantages: 1, Starting with a 600-flash cylinder stock with a viscosity of 150 sec. at 210 deg. F., Chlorex treatment makes it possible to finish up a less viscous (140–138 sec. at 210 deg. F.) bright stock. By this reduction in viscosity about three percent to four percent more bright stock will go into motor-oil blends than when refining conventionally by dewaxing and percolating to the same pour point and color; because without the solvent the reduction in viscosity at 210 deg. F. is very slight. 2, Starting with a cylinder stock of 160–162 sec. at 210 deg. F., Chlorex extraction by reducing the viscosity will permit finishing up a bright stock of 150–148 at 210 deg. F. When running to the more viscous cylinder stock, some of the viscous oil which normally goes into the bright stock is taken into a slop wax cut, which may be dewaxed with propane or thermally-treated to permit filter pressing for wax removal. It has been estimated by several Pennsylvania refiners that, taking all factors into consideration, the latter method described above will show an increase in neutral production of two percent to 2½ percent, based on the crude, or 17 percent to 20 percent, based on neutral, and a decrease in bright-stock production of about 2½ percent to three percent, based on the crude, or 15 percent to 20 percent, based on bright stock.

Many Pennsylvania refiners feel that viscosity reduction of cylinder stocks by solvent means will pay for the cost of extraction and also compensate for extract losses which are sustained in solvent treating. Considering this, and the increase in percolation yields obtained, Chlorex extraction of Pennsylvania oils should not increase refining costs, and may show some savings. Profitable disposal of extracts is being closely studied, and applications in certain directions offer promise.

With regard to improvement in oxidation resistance, conventionally-refined Pennsylvania SAE-20 and -30 motor oils will generally show about 50 to 55 hours for 10 mg. of sludge on the Indiana oxidation test. A number of oxidation tests have been run on SAE-20 and -30 blends made up of Chlorex-treated neutral and bright stock. All of these have shown better than 200 hours on the Indiana test with no sludge formation.

Chlorex is peculiarly well suited to the treatment of overhead stocks from Mid Continent and Coastal crudes. Results obtained with Chlorex on a typical SAE-20 Mid Continent distillate, dewaxed to a 25-deg.-F. pour point, are shown in Table 4. This oil was treated in 6-stage, continuous, counter-current extraction equipment at a temperature of 60 deg. F., using a 144-to-1 Chlorex-to-oil ratio.

A very marked improvement in the color has been effected by the action of Chlorex alone. The stock came direct from the still, and received no acid or clay treatment prior to Chlorex extraction. A 71.5-percent yield of raffinate was obtained, showing an improvement in viscosity index from 60.5 to 92.5. With a 63-percent yield, a viscosity index of 100 was readily obtained on this oil.

The raffinate was finished to a 3½–4 color with a clay yield of 4,000 gal. per ton of No. 1 Attapulgus clay.

When treating distillates from Coastal crudes, low yields must be expected if a 100-VI oil is desired. For this reason, a moderate improvement in viscosity index appears more logical. Table 5 shows results obtained with Chlorex on overhead distillate blend from Coastal crude. This extraction was run 7-stage, batch, countercurrent, at a temperature of 60 deg. F. using a 1½-to-1 Chlorex-to-oil ratio.

With a 64.8-percent raffinate yield a viscosity-index improvement from 21 on the original stock to 65.5 on the raffinate was obtained. The raffinate was finished to a 2½ NPA color, with a percolation yield of 5,900 gal. per ton of No. 1 Attapulgus clay. Chlorex extraction of this stock is accompanied by improvement in other properties, such as steam-emulsion number, demulsibility, and acidity.

Several of the refiners in the Mid Continent field are considering installation of a Chlorex plant to treat Mid Continent neutrals and possibly bright stock. On a Mid Continent neutral, a viscosity index of 100, or better, can be readily obtained with Chlorex, with yields from 60 percent to 75 percent. Acid treatment will not be necessary, and solvent treatment should show real savings in clay costs. Assuming that such a neutral were available, motor-oil blends could be made with this neutral and: I, 150-viscosity Mid Continent bright stock finished conventionally with acid and clay or, II, the same bright stock

TABLE 4

Data on Mid Continent Distillate

	Original	Raffinate
Yield, percent by volume	100	71.5
Gravity, deg. API	24.0	30.0
Saybolt Universal viscosity at 210 deg. F.	52.7	49.9
Saybolt Universal viscosity at 100 deg. F.	348.1	267.8
Viscosity index	60.5	92.5
Viscosity-gravity constant	0.853	0.815
Color, NPA	...	4½ to 5
Color, true	331	50
Pour point, deg. F.	25	30
Carbon residue, percent	0.17	0.02
Emulsion test in 1 hour	2 cc.	OK
Neutralization No.	0.36	0.14

TABLE 5

Data on Distillate Blend from Coastal Crude

	Original	Raffinate Before Claying	Raffinate Finished	Extract
Yield, percent by volume	100	64.8	...	35.2
Gravity, deg. API	20.4	25.0	25.0	11.9
Color, true	85	34	7	...
Color, NPA	...	4½	2½	...
Pour point, deg. F.	−10	−5	0	...
Carbon residue, percent	0.16	0.02	0.01	...
Saybolt Universal viscosity at 210 deg. F.	61	59.9	60.2	93.8
Saybolt Universal viscosity at 100 deg. F.	741	544	550	...
Viscosity index	21	65.5	67	...
Viscosity-gravity constant	0.875	0.840	0.839	0.937

TABLE 6

Data on Mid Continent Neutral and Bright Stocks

	*Neutral	Bright Stock	Treated Bright Stock (87.5-Percent Yield)
Gravity, deg. API	31.1	23.2	25.4
Flash point, deg. F.	430	535	560
Fire point, deg. F.	490	635	640
Pour point, deg. F.	5	5	5
Color, Tag-Robinson	...	1	1½
Color, NPA	2½	...	...
Color, ASTM	2−	4− dilute	4− dilute
Carbon residue, percent	0.018	1.79	1.11
Saybolt Universal viscosity at 100 deg. F.	211	3,512	2,609
Saybolt Universal viscosity at 130 deg. F.	110 †	...	...
Saybolt Universal viscosity at 210 deg. F.	47.5	162.5	145.9
Viscosity index	102	80	89

* Contains 0.1 percent paraflow.
† A.S.T.M. chart.

TABLE 7

Blend of Chlorex-treated Neutral and Conventionally-refined Bright Stock

	SAE-20	SAE-30	SAE-40	SAE-50
Neutral, percent by volume	93	73	59	43
Gravity, deg. API	30.4	28.9	27.9	26.6
Flash point, deg. F.	435	455	465	475
Fire point, deg. F.	500	515	525	540
Pour point, deg. F.	5	5	5	5
Color, ASTM	3.5	5—	6—	6
Carbon residue, percent	0.10	0.42	0.74	1.0
Saybolt Universal viscosity at 100 deg. F.	248	405	593	914
Saybolt Universal viscosity at 130 deg. F.	129	196	269	370 *
Saybolt Universal viscosity at 210 deg. F.	49.6	58.3	67.4	81.0
Viscosity index	101	97	93	88
Sligh No.	2.7	2.5	1.5	1.0

* From A.S.T.M. chart.

which has been treated with Chlorex with a moderate extract loss of, say, 12½ percent.

In order to study these possibilities, two series of motor-oil blends, SAE-20 to SAE-50, inclusive, have been prepared. The same neutral, a typical Chlorex-treated Mid Continent distillate of 102 VI was used in both series. Tests of this neutral and the Chlorex-treated and untreated bright stocks are given in Table 6.

The data in Table 6 show that Chlorex treatment of the conventionally-refined Mid Continent bright stock has resulted in a reduction in Conradson carbon residue from 1.79 percent to 1.11 percent on the treated oil. There is no increase in pour point. The viscosity index has been increased from 80 to 89.

Inspections on motor-oil blends, secured by blending the Chlorex-treated neutral with the conventionally-refined Mid Continent bright stock, are given in Table 7.

The viscosity index of the SAE-20 oil in Table 7 is better than 100, while the viscosity index of the SAE-30 oil is slightly under 100. There is a progressive improvement in the oxidation resistance of these oils, as measured by the Sligh test, which is to be expected as the amount of bright stock in each blend increases.

The viscosity indices in Table 7 were calculated from the Saybolt Universal viscosities of these oils. If these figures had been based on the kinematic viscosities, it is probable that the viscosity indices would have been somewhat lower. Although many feel that viscosimeters for measuring kinematic viscosities give more accurate results than the Saybolt instrument, particularly on the lighter oils, it is, nevertheless, true that the Saybolt viscosimeter is in very general use throughout the country, and Saybolt viscosities are still generally used in reporting oil specifications. Further improvement in the viscosity index of the oils in Table 7 can be secured by the addition of Paratone to the bright stock used in the blends.

Inspections on a series of motor oils made by blending Chlorex-treated Mid Continent neutral with the 150 bright stock after treatment with Chlorex, with a 12½-percent loss, are shown in Table 8.

It will be noted that the SAE-20 and SAE-30 oils both have a viscosity index of better than 100, while the SAE-40 oil has the same viscosity index as the SAE-30 oil in Table 7. As a result of the increased demand for lighter oils, it appears that the bulk of the demand for motor oils will be supplied with SAE-30 grade, or lighter. Table 8 shows that oils of 100 viscosity index, or better, to meet this demand can be made by blending a Chlorex-treated Mid Continent neutral with a conventionally-refined Mid Continent bright stock, also treated with Chlorex with a low extract loss.

Also of interest is the improvement in Conradson carbon residue which has been obtained by blending the neutral with the Chlorex-treated rather than the conventionally-refined bright stock. The carbon residues in Table 8 are approximately half those in Table 7. Further improvement in resistance to oxidation, as measured by the Sligh No., has been obtained by treating both blending stocks with Chlorex.

TABLE 8

Blends of Chlorex-treated Neutral and Bright Stocks

	SAE-20	SAE-30	SAE-40	SAE-50
Neutral, percent by volume	93	71	54	40
Gravity, deg. API	30.7	29.4	28.5	27.7
Flash point, deg. F.	435	455	465	475
Fire point, deg. F.	500	515	525	540
Pour point, deg. F.	5	5	5	5
Color, ASTM	3.5	5—	6—	6
Carbon residue, percent	0.07	0.28	0.42	0.56
Saybolt Universal viscosity at 100 deg. F.	244	394	594	849
Saybolt Universal viscosity at 130 deg. F.	129	194	271	355 *
Saybolt Universal viscosity at 210 deg. F.	49.5	58.5	68.5	80.9
Viscosity index	102	102	97	95
Sligh No.	1.5	1.3	0.6	0.6

* From A.S.T.M. chart.

Although Chlorex shows a very marked improvement, with low extract losses, on residual stocks from Pennsylvania crude, when extracting a Mid Continent long residuum, which may contain from 5 percent to 15 percent asphalt and other undesirable constituents, it is usually necessary to acid-treat the stock or de-asphalt it in propane before solvent extraction. Typical results obtained on a propane-de-asphalted Oklahoma City long residuum with Chlorex are given in Table 9. The de-asphalted stock was treated in 7-stage, batch, counter-current equipment at a temperature of 80 deg. F. with a 2-to-1 Chlorex-to-oil ratio by volume.

This same stock was extracted with Chlorex after acid treating with 1 lb. of acid per gallon, under the following conditions:

Chlorex-to-oil ratio.....2 to 1
Extraction temperature.....100 deg. F.
Method—4-stage, batch, counter-current

TABLE 9

Data on Oklahoma City Long Residuum

	Original Wax-bearing Stock	Original Stock De-asphalted (Dewaxed only)	Raffinate from De-asphalted and Dewaxed Stock	Finished Raffinate*	Extract from De-asphalted and Dewaxed Stock
Yield, percent by volume	100	76.2	58.0	98	42
Over-all yield, percent	100	76.2	44.2	43.6	...
Gravity, deg. API	19.9	20.7	26.3	27.7	11.8
Saybolt Universal viscosity at 210 deg. F.	141	128.5	113.6	92.2	235
Saybolt Universal viscosity at 100 deg. F.	3,180	2,709	1,581	1,050	...
Viscosity index	68.5	65.5	94.6	98.4	—78 approximate
Viscosity-gravity constant	0.861	0.856	0.816	0.809	0.922
Color, true	10,100	2,000	1,650	25	...
Color, NPA	...	...	...	3½ to 4	...
Pour point, deg. F	75	0	5	5	...
Neutralization No.	0.16	0.15	0.15	0.14	...
Carbon residue, percent	5.93	3.22	1.53	0.34	...

* Raffinate percolated through No. 1 Attapulgus clay.

TABLE 10

Data on Oklahoma City Long Residuum

	Original Wax-bearing Stock	Original Wax-bearing Stock Acid-treated	Raffinate from Acid-treated Stock	Dewaxed Raffinate	*Percolated Dewaxed Raffinate
Yield, percent by volume	100	69.2	65.7	75	95
Over-all yield, percent	100	69.2	46.4	34.8	33.0

*Percolated to 4–4½ NPA color.

The yields secured are given in Table 10, and it will be noted that there is some sacrifice in yield when using acid instead of propane for de-asphalting—although the physical properties of the finished oil were equally good. In acid treating, however, no additional investment is required for equipment, as the present acid-treating plant may be used for this preliminary step—thus eliminating the investment required for a propane de-asphalting plant.

As a matter of interest, a Mid Continent long residuum, conventionally refined by acid treatment, by centrifugal dewaxing, and by percolation, was treated in seven-stage, continuous, counter-current apparatus at a temperature of 105 deg. F., using a 3-to-1 Chlorex-to-oil ratio. The results are given in Table 11.

A 72.4 percent yield of 99.2-VI oil was secured. This extraction was run simply to determine what loss would be encountered in making a 100-VI oil from an 80- to 85-VI conventionally-refined Mid Continent stock of this kind. By the use of a vacuum still, those refiners who are running a long residuum can take their lubricating stocks overhead from the topped crude. This method of refining will provide greater flexibility in controlling neutral and bright-stock production to meet changing marketing conditions, and the overhead stocks will be clean and relatively free from asphaltic materials—and may be readily solvent-extracted with a single solvent, such as Chlorex.

Figure 2 is a typical flow diagram of a Chlorex plant using the latest design of extraction equipment and vacuum distillation for continuous recovery of the solvent from the raffinate and extract solutions. Operation is as follows:

The charge oil is pumped through a heat exchanger *M*, which is operated either as a cooler or heater, depending on whether water or steam is circulated through the unit. Chlorex-extraction temperatures range from 60 deg. to 125 deg. F., depending on the stock and the results desired. The rate of pumping of the charge oil is under automatic flow control. The pre-heated or precooled oil is mixed in the first-stage pipe mixer, with the extract solution (thrice-used Chlorex) from the second stage. This mixture then settles in the first-stage settling tank. The extract solution from the first-stage settler is pumped, under automatic float control, to the extract-solution distillation unit for continuous recovery of the solvent. The raffinate solution from the first stage flows under first-stage pressure, and is mixed in the second-stage pipe mixer with the extract solution from the third stage. This mixture settles in the second-stage settling tank. The raffinate solution from the second-stage settler is mixed with the extract solution from the fourth stage (once-used Chlorex) in the third-stage pipe mixer, and this mixture settles in the third-stage settling tank. The raffinate solution from the third-stage settling tank is mixed with fresh Chlorex in the fourth-stage pipe mixer. This mixture settles in the fourth-stage settling tank. The final raffinate solution, from the fourth stage, is pumped under automatic control to the raffinate-solution distillation unit for continuous recovery of the solvent.

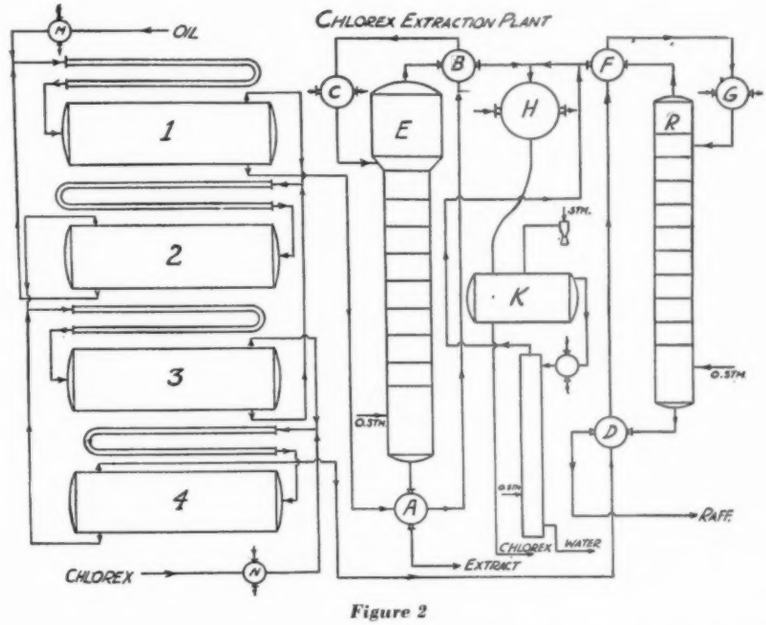


Figure 2

Figure 2 illustrates a design for four-stage counter-current operation. There does not appear to be any advantage in going to more stages when treating overhead or residual stocks from Pennsylvania crude. However, when treating Mid Continent and Coastal oils, it is usually desirable to use 5, 6, or even 7 stages. When using more stages, the operation of the extraction equipment is the same as described above.

A compact extraction unit is made by installing the horizontal settling tanks one above the other in structural-steel framework. The first (top) stage is main-

TABLE 11

Data on Mid Continent Long Residuum

	Original Oil	Raffinate	Contacted Raffinate	Extract
Contact clay, gallons per ton	...	...	8,000	...
Yield, percent by volume	100	72.4	...	27.6
Gravity, deg. API	25.0	28.4	28.5	16.7
Viscosity-gravity constant	0.828	0.802	0.802	0.893
Flash point, deg. F.	470	480	480	460
Fire point, deg. F.	545	560	560	530
Pour point, deg. F.	5	5	5	10
Color, Tag-Robinson	1⅜	1⅝	1⅝	¼
Carbon residue, percent	1.15	0.59	0.57	2.80
Saybolt Universal viscosity at 100 deg. F.	1,237	1,103	1,112	2,792
Saybolt Universal viscosity at 210 deg. F.	91.6	94.8	95.2	105.7
Viscosity index	81.9	98.7	99.2	10.8

tained under the highest pressure, varying from 75 to 100 lb. per sq. in. The pressure drops in increments of 10 lb. to 15 lb. per stage as the raffinate solutions flow downward from stage to stage, while the extract solutions are pumped with float-controlled pumps in the opposite direction. Chlorex is charged to the system with an automatically-controlled pump through a heat exchanger, *N*, through which either water or steam may be circulated for heating or cooling the solvent.

The solvent-recovery system is maintained under a vacuum of 26 in. to 28 in. mercury, and the solvent is completely recovered from the oil at a maximum stripping temperature of 300 deg. to 325 deg. F. The distillation equipment shown in Fig. 2 is steam-heated. Direct-fired vacuum-distillation units are also being used successfully for recovering Chlorex, and the choice of equipment depends to a large degree on whether sufficient live steam is available in the refinery to operate the unit.

The final extract solution from the first-stage settling tank passes through a heat exchanger, *A*, utilizing the heat in the stripped bottoms from the extract-distillation unit, *E*. Further heat is supplied to the extract solution in a second heat exchanger, *B*, utilizing the heat in the hot Chlorex water vapors from the extract unit. Any additional heat required for distillation is supplied with a steam pre-heater, *C*. The extract solution enters the stripping column near the top. Open steam is applied at the bottom of the column. Re-boiler coils may be used to maintain the temperature throughout the column, which is a simple fractionating column with bubble trays.

The final raffinate solution from the fourth stage is heated with bottoms and vapor heat exchangers, *D* and *F*, and a steam pre-heater, *G*. As the raffinate solution will contain only 15 percent to 25 percent solvent, the raffinate-stripping unit, R, is considerably smaller than the extract unit, *E*, where the bulk of the solvent is recovered. Hot Chlorex water vapors from the extract and raffinate-solution distillation units pass through a water-cooled condenser, *H*—the condensed Chlorex and water flowing to a settling tank, *K*, where the solvent is separated from the water by gravity and returned to storage for re-use. The water will be saturated with Chlorex with a solvent content of approximatly one percent. This water is fed through a pre-heater to a small, packed column, which may be readily constructed from a piece of casing of the proper length and diameter. Open steam is added near the bottom of this column. Water which is completely denuded of Chlorex flows to the sewer under automatic float control from the bottom of this tower, while the vapors which are rich in Chlorex pass to the raffinate-extract vapor condenser, *H*. A vacuum is maintained on the system by means of a steam-jet vacuum pump. It is not necessary to operate the water-stripping column under a vacuum. A Chlorex plant of this design, for treating 1,000 bbl. of oil per day, will require a total ground space not over 50 ft. square. From 15,000 gal. to 20,000 gal. of solvent is adequate.

Four Chlorex plants using stills already available in the refinery for recovering the solvent were built at an out-of-pocket cost averaging $41 per barrel of combined charging capacity. A 1,000-bbl.-per-day plant using distillation equipment of this type could, therefore, be installed for around $40,000. Five-hundred, barrel-per-day plants built new from the ground up, incorporating continuous vacuum-distillation equipment for recovering the solvent, may be installed at a price range from $120 to $180 per barrel charging capacity; while a 1,000-bbl.-per-day plant can be built for between $80 and $110 per barrel charging capacity. Operating costs in plants with continuous vacuum-distillation equipment will run from 0.4 cents to 0.5 cents per gallon of oil charged, which includes steam, water, electricity, fuel, Chlorex loss, maintenance, depreciation, and labor.

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Measuring Petroleum Colour

A STANDARD method of measuring and recording the colour of oils has always been one of the ideals of the oil chemist. The days when it was sufficient to describe the colour in arbitrary and ambiguous terms has long since passed. It is frequently of interest to note any colour changes which may take place during storage or refining and record these differences in quantitative terms. The whole problem of colour measurement has been considerably simplified since the advent of The Lovibond Tintometer, The British Drug Houses Pattern, Pat. No. 299194, and the usefulness of this apparatus has been further extended by the introduction of an artificial lighting device to give constant and even illumination comparable with north daylight. The Tintometer consists of a bakelite box which contains a number of racks into which are fitted tintometer colour slides. These racks are moveable from left to right and each colour slide in turn passes in front of a mirror placed at 45 deg. inside a vertical tube at the centre back extremity of the bakelite box. Another mirror also placed at 45 deg. inside the viewing tube reflects the colour of any substance which is placed in front of it.

The two fields of view are immediately adjacent to each other so that it is a simple matter to adjust the racks until the two colour fields match one another. When this is accomplished the value of the tintometer slides effective in front of the first mirror can be read off an indicator at the top of the bakelite box. In the standard models supplied for most commercial purposes the instrument is fitted with the well known red, yellow and blue slides, but special racks containing the I.P.T. colour standards for kerosenes, etc., or the A.S.T.M. colour slides for petroleum oils can also be fitted.

The light attachment makes the apparatus available at all times where a steady supply of electric current is available and provides a constant and even illumination of both fields of view.

The horizontal type of cell used in the old form of apparatus up to six inches in length will fit into the light attachment in its normal horizontal position, but an extension to the light attachment permits the use of cells up to 18 inches long, which is the length of cell specified by the Institution of Petroleum Technologists for testing kerosenes, etc. The use of these long cells necessitates the apparatus being turned over.

The vertical type of cell facilitates the handling of samples and prevents spilling.

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TRIALS of the M T BRASIL for The Texas Co. (Norway) Ltd., were run early in May by the Danish builders, Nakskov Shipyard. The BRASIL is about 12,300 tons d. w. capacity, propelled by twin B. & W. Diesel engines aggregating 4,100 I. H. P. capable of 13 knots average loaded. She is equipped with 200 B. H. P. auxiliary Diesels.

World Petroleum Abstracts

Summaries of the Most Important Articles as Published in the Oil Press of the World Dealing With Technical and Economic Aspects of the Industry.

Dr. O. W. Wilcox

Petroleum Geology

EXPERIMENTS ON SOFT-ROCK DEFORMATION.—R. E. Rettger, in BULL. AM. ASSOC. PETROL. GEOLOGISTS, vol. 19 (1935), No. 2. pp. 271–292; (16 figs.).

The paper describes laboratory experiments illustrating deformation of soft sediments produced by slump, differential movements, and differential loading. It explains some of the structures developed, and suggests criteria by which soft rock deformation may be differentiated from hard rock deformation.

OIL AND GAS POSSIBILITIES OF WESTERN WHATCOM COUNTY, WASH.—Sheldon L. Glover, in REPORT OF INVESTIGATIONS NO. 2, Wash. Dept. of Conservation (1935).

Gives the oil and gas geology of parts of Whatcom County in the State of Washington, with maps and well records.

ATHABASKA OIL SANDS: APPARENT EXAMPLE OF LOCAL ORIGIN OF OIL.—Max W. Ball, in BULL. AM. ASSOC. PETROL. GEOLOGISTS, vol. 19 (1935), No. 2, p. 153.

In the debate on local origin versus long-distance migration of oil, some consideration may well be given to the oil sands of northern Alberta, Canada. Here are many thousands of square miles of oil-saturated sands, containing up to 100,000 and more barrels of oil per acre. Estimates of the total oil content run from 100 billion to 250 billion barrels. The oil sands seem to lie too flat to have induced oil migration. There is no suggestion of artesian or metamorphic fluid movement into the area from without. The sand appears to be saturated throughout most if not all of its horizontal extent; there seems to be no large additional sand area whence the oil in the saturated area might have migrated. Whether the oil originated in overlying beds and migrated downward into the sand, or in underlying beds and migrated upward, or in the sand itself, the evidence suggests that the oil originated in its present location.

STRUCTURAL BASIN POSTULATED FROM SALINITY DATA.—W. Armstrong Price, in BULL. AM. ASSOC. PETROL. GEOLOGISTS.—Vol. 19 (1935), No. 3, pp. 317–355.

From analyses of subsurface waters the author postulates the existence of a structural basin in the region of Corpus Christi, Texas.

RELATION OF GEOPHYSICS TO SALT-DOME STRUCTURES.—J. Brian Eby and Robert P. Clark, in BULL. AM. ASSOC. PETROL. GEOLOGISTS, vol. 19 (1935), No. 3, pp. 356–377; 18 figs.

The primary object of this paper is to assemble and present a selective set of geophysical pictures found by investigating several types of Texas and Louisiana Gulf Coast salt-dome structures.

The paper presents eighteen geophysical maps covering nine salt domes and deep-seated structures. Two shallow domes, namely, Moss Bluff and Fannett, are given. Fannett is a gravity maximum, and Moss Bluff is a combination of a gravity minimum and maximum. The Sugarland dome is given as an example of a medium-depth structure, which is indicated by the torsion balance as a minimum. Six deep-seated structures are shown, including Sheppards Mott, Pledger, Mykawa, Tomball, Livingston, and English Bayou-Gillis. The deeper-seated structures invariably show a gravity-minimum influence.

A refraction seismograph map of Moss Bluff is given, and reflection-seismograph maps are given for Sheppards Mott, Tomball, and English Bayou-Gillis. A magnetic map of the Fannett field is likewise presented.

EXPLORING OIL STRUCTURES BY MEASURING THE APPARENT SPECIFIC RESISTANCE.—A. Belluigi, in PETROLEUM, vol. 31 (1935), No. 5, pp. 1–2.

The Geophysical Division of the Italian Oil Trust (A.G.I.P.) has constructed an exceedingly accurate instrument for measuring differences in potentials among the strata of an oil well. Potentials ranging from 0.001 ohm to 10 ohms can be measured within a range of error of 0.9 to 2 percent.

NEW TYPE OF CRUDE OIL.—Anon. PETROL. ENG., vol. 6 (1935), No. 6, p. 75.

It has already been observed that almost all conceivable varieties of crude oils are being produced in the various Texas fields, from the highly paraffinic Ranger crude through the mixed bases of North and East Texas and the asphaltic and naphthenic crudes of the Gulf Coast; to this range has now been added the highly aromatic crudes of the South Texas fields. These are found in the Sam Fordyce field in Hidalgo county, which is less than a year old and has a present potential production in excess of 15,000 bbl. daily. This crude contains no gasoline or kerosene fractions, has a small cut resembling furnace oil with the extremely low gravity of 31.1, a 53.4 percent cut marketable as a zero cold test gas oil, a 36.3 percent cut of inferior lubricating oil, and 2.94 percent carbon residue. Paraffinic components are practically absent; there is little sulphur or asphalt, and the oil seems to consist chiefly of aromatic hydrocarbons. By cracking it will yield 75 to 80 percent of very high anti-knock gasoline-like fractions.

TATUMS POOL, CARTER COUNTY, OKLAHOMA.—Glenn Grimes, in BULL. AM. ASSOC. PETROL. GEOLOGISTS, vol. 19 (1935), No. 3, pp. 401–411. 3 figs.

This pool is to be regarded as flank production of the great Arbuckle anticlinorium. Information and evidence are introduced to show that the production is from beds which have overlapped an old eroded surface, and also that the upper part of the producing sand is locally an erosional surface. The pool has a producing area of about 1,800 acres, although an approximate maximum of only 150 acres would be productive if it were not for the fact that the pay sand is sealed up by the dip.

PROGRESS AND DEVELOPMENT OF GEOPHYSICAL METHODS IN ROUMANIA.—T. P. Ghitulescu, in ANN. MINES ROUMANIE, vol. 18 (1935), No. 2, pp. 59.

The author reviews all geophysical methods now used for geological explorations in Roumania, including those of special application to the search for petroleum. In general, the electric coring method of Schlumberger has proved useful, and the gravimetric method has been used successfully to delimit an important oil zone, but a case is recorded of well confirmed failure. Two different electrical methods and the gravimetric method, applied by three different geophysical companies, indicated with perfect concordance the existence of an anticlinal axis, but extensive and costly drilling failed to confirm the finding. This insuccess is cited as a warning to proceed with all possible caution in these matters.

STRUCTURAL DEVELOPMENT OF TRANS-PECOS, TEXAS.—Philip B. King, in BULL. AM. ASSOC. PETROL. GEOLOGISTS, vol. 19 (1935), No. 2, pp. 221–261. (7 figs.)

The mountain area of trans-Pecos Texas is divisible into a northern part, which has been more or less stable, and a southern part, which has shown considerable mobility from Paleozoic down to Cenozoic time. Strong folds and overthrusts of late Pennsylvania age, raised from a geosyncline, are found in the Marathon and solitario uplifts in the southern part of the province. Northwest of them, in the stable area, Permian rocks later than the deformation lie unconformably on broadly folded older Paleozoic foreland rocks, and were deposited in broad basins.

In some mountain ranges of western trans-Pecos Texas, and extending southward into Mexico, are close folds and overthrusts raised from a Mesozoic geosynclinal area. East of them are broad folds, domes, and basins of marginal type. These structural features were produced during two movements, one older and the other younger than the extensive Tertiary lavas of central trans-Pecos Texas. These may be classed as the northern ends of

the Sierra Madre Oriental of Mexico. After the last folding, trans-Pecos Texas was extensively broken by normal faults, some of the movements being of late Tertiary age, and some of relatively recent date. In the northern stable part of the province, features of Basin and Range type were produced. Here, thick intermontane deposits were laid down in the areas depressed by faulting. The present surface features of trans-Pecos Texas result in part directly from the various later tectonic movements, and to a greater degree from the modification of the structural features by stream erosion.

THE NEW SEISMOS GRAVIMETER.—St. v. Thyssen, in PETROLEUM, vol. 31 (1935), No. 5, pp. 2–3.

For detecting differences in gravimetric density of the earth's crust use has generally been made of the pendulum method, mostly the "invariable" pendulum according to v. Sterneck. This method is relatively cumbersome and slow, and requires a large and highly trained personnel. The most one pendulum crew can do is about 25 stations a month, and the cost is large. The new gravimeter of Thyssen and Schleusener weighs only 33 pounds, and not only permits rapid work but is much more accurate than the Sterneck instrument.

MINERAL CONTENT OF PETROLEUM.—E. Longobardi, in JOUR. INST. PETR. TECHNOLOGISTS. Vol. 21 (1935), No. 136, pp. 132–134.

A list is given of elements that have been found in crude petroleum. So far oil chemists in various parts of the earth have found Si, As, Al, Fe, Ca, Mg, Cu, Ag, Au, V, Na, Ti, Pb, Sn, Ni, Mn, Cr, Ba, Sr, K, and Li. The association of these elements with petroleum is of some interest, as there are occasions where such association can be used for drawing inferences regarding the origin of a given oil pool. It is of interest to note that the ash of lignite deposits of San Rafael (Argentina) contains a notable percentage of vanadium, which is also found in the ash of a nearby petroleum deposit in amounts warranting its recovery from furnaces in which this crude oil is burned.

BUCKEYE FIELD, MATAGORDA COUNTY, TEXAS.—E. W. Brucks, in BULL. AM. ASSOC. PETROL. GEOLOGISTS, vol. 19 (1935), No. 3, pp. 378–400; 4 figs.

The Buckeye field is on a very deep-seated domal uplift; it covers about 800 acres, according to the surface indications and a magnetometer survey. The first well drilled came in as a producer, August 31, 1932. Seven wells have been completed, and of these, two were commercial producers. The wells on a west-east cross section indicate that the uplift may cover less than 800 acres. A study of the subsurface reveals that the Upper Catahoula is undoubtedly of Miocene age. The oil horizon occurs in the upper part of the Lower Catahoula (Frio), at the depth of approximately 7,800 feet. This was the deepest commercial oil production in the Texas Gulf Coast at the time of its discovery. The field produced 362,397 barrels before the wells stopped flowing, and is still producing small quantities of oil on the pump. The field has been subdivided into 20-acre units.

Drilling

CONTROL OF COLLOIDAL PROPERTIES OF MUD.—Wallace A. Sawdon, in PETROL. ENG., vol. 6 (1935), No. 5, pp. 50–56.

Besides its function to supply a static head against formation pressure, a drilling mud must contain colloidal material that will hold solids in suspension when circulation is stopped, and to seal up formations against penetration by water, gas or oil. Colloidal properties are supplied to the mud by additions of various substances, such as specially treated bentonites. The colloid content is subject to change with the progress of drilling and is a factor that should be kept under control. For this purpose an automobile rigged out as a traveling laboratory that can make the rounds of wells in the field and make tests on the spot will be a convenience. The author supplies a description of such a traveling laboratory and outlines the testing procedure.

FUNDAMENTALS OF CASING JOINT DESIGN AND FIELD APPLICATION.—James A. Graham and Earle E. Smith, in OIL & GAS JOUR., vol. 33 (1935), No. 41, pp. 29–30; 67–68.

Deep well drilling has increased greatly in the last few years; several strings of casing have been set deeper than 9,000 feet and one has reached a length of 10,301 feet. The existing A.P.I. specifications did not contemplate such a condition, and since even longer strings may be called for in the near future it is necessary to review the fundamentals of the problem. The classes of steel now most suited to casings are grade "C" with tensile strength of 75,000 lbs. per square inch, and grade "D" with a strength of 95,000 lbs. minimum. The authors figure that with a safety factor of 2, steel of 105,000 lbs. tensile strength could be set at about 15,442 feet, if the joints were as strong as the body of the casing, and this raises the question of joint strength. After reviewing this angle of the matter at considerable length the authors conclude that by upsetting the ends of casing, joints can be made that will develop the full strength of the casing wall. If these upset joints are fitted with heat-treated alloy steel couplings, the outside diameter can be kept as small as that on the present standard casing which is not upset.

Wherever it is essential to reduce joint diameters for the purpose of gaining greater clearance in the open hole, thin wall couplings may be used with a minimum sacrifice of strength, and such joints will retain all the advantages now afforded by conventional threadings.

Oil Well Operation

LOCATING WATER ENTRY IN FLOWING WELLS.—Wallace A. Sawdon, in PETROL. ENG., Vol. 6 (No. 6), pp. 30–32.

An equipment known as a "droplet counter" has been developed by Oilfields Service Co. for locating water entry in flowing wells without suspending the normal flow or altering the surface conditions. The function of the equipment is to indicate the frequency of impinging droplets of water in a flowing column of oil, gas and water as they pass through a detector which is caused to traverse the well. In addition to this frequency measurement the equipment also records the "dielectric" or mass resistance of the fluid; variations of the dielectric resistance indicate the differences in the concentration of the fluid mixture. These two measurements—the frequency count and the dielectric resistance—serve to mark the point where the upward moving column of oil is receiving water from the formation.

In making a test the detector is run to the bottom of the well and then hauled upward. The apparatus is equipped with electrodes supplied with current from above through an insulated cable, the indications of the electrodes being recorded by two oscillographs at the surface; one oscillograph records the frequency impingements of droplets of water and the other registers the different dielectric values. Oscillations of both wires are photographed on sensitized paper in a camera that rotates the film in synchronization with the travel of the detector in the well; the one measurement checks the other and both combine to give usable information as to points where water is entering.

BACKSIDE CRANK PUMPING.—H. E. McCray, in PETROL. ENG., vol. 6 (1935), No. 6, pp. 66–71.

This article gives an illustrated description of the apparatus and methods of modern backside crank-pumping, whereby four or more wells are pumped by the same engine. A first-class installation of an excellent plant of this type is said to cost about $1,200 per well.

BENEFITS FROM UNIT OPERATION.—F. W. Floyd and M. L. Raider, in OIL & GAS JOUR., vol. 33 (1935), No. 39, pp. 10–11, 21.

In the Community 28 block near Keokuk Falls in Seminole County, Oklahoma the rate of production is determined from a study of bottom hole pressure and reservoir conditions. By this means the rate of production is kept closely in balance with the rate of encroaching edgewater. The results emphasize sharply the value of pool unitization which permits orderly development and proper control of well spacing and production rate. The block consists of 1,360 acres of which 1,100 are expected to be productive. There is one well to 40 acres.

To show the superiority of unitization over competitive drilling the authors make comparisons with neighboring fields, much to the disadvantage of the latter. Whereas under unrestricted development of these pools the number of flowing wells decreased very rapidly, all the wells of Community 28 block are still flowing with undiminished pressure nearly two years after the first well was drilled.

MODERN OILFIELD GAS ENGINE DESIGN.—A. K. Hegeman, in PETROL. ENG., Vol. 6 (1935), No. 6, pp. 36–38.

Progressive manufacturers of oilfield internal combustion engines have devoted the slack time of the depression to research and design work in the improvement of their equipment; the general object of these efforts has been to obtain more horsepower per pound of metal, which means more power per dollar of cost. This object has been sought along three principal lines: lighter, higher speed designs; increase of piston speed of present designs, and increased thermal and mechanical efficiency through improvement of existing designs.

The light, high speed designs are finding increased use for pumping purposes and for auxiliary purposes in absorption plants and compressor stations, and with suitable modifications are being supplied as units for both well servicing and pumping. Regarding the second method of obtaining more power per dollar of cost, which is by increasing the piston speed of existing units, from the builder's standpoint this is the least costly method that can be used. Competitive conditions have reached a stage where there may be a tendency to resort to this type of unit, but the author advises against it, because increase in speed involves a disproportionate increase in the stresses to which the unit is subject, leading to excessive wear, tear and repair.

As against the two lines of improvement sketched above, the main activity of conservative designers has been in the improvement of existing designs. Governing has not only been improved but perfected. Power and compressor cylinders honed to a tolerance of .0005 inch throughout their entire length are offered by two manufacturers, who thus add two or three years to the life of the cylinder. What appears to be the most striking improvement in engine design is the work of one manufacturer in developing a 17" x 20" 2-cycle power cylinder with overhead exhaust that increases mechanical efficiency five percent, reduces scavenging horsepower loss 25 percent, eliminates injection of cooling water, and practically abolishes detonation.

The author concludes by stating that in the past five years engine design has been so improved that purchase by oil companies of used equipment built prior to 1930 cannot be justified from an economical standpoint.

Development of Wire Rope Pumping in Roumania.—Percy R. Clark and Lutz F. W. Schropp, in PETROL. TIMES, vol. 32 (1935), No. 841, pp. 227–230.

According to the authors, pumping oil with ropes will save time and money, if the rope has the necessary qualities. These are: minimum tendency to elongate, minimum tendency to rotate, stiffness, and resistance to abrasion. The paper contains numerous suggestions for pumping by this method.

Methods Employed at a Central Mud Plant.—J. C. Albright, in PETROL. ENG., vol. 6 (1935), No. 6, pp. 99–104.

When a single company is drilling a number of deep wells in the same field, with the character of mud called for at different wells subject to variation within a few hours, with muds costing $3.00 per bbl., and a daily accumulation of discarded mud in excess of 320 bbl. the necessity for a well organized and smoothly working mud-reclaiming department is self evident. The author here describes the installation and operation of a central mud plant that is effecting very large economies.

Natural Gas

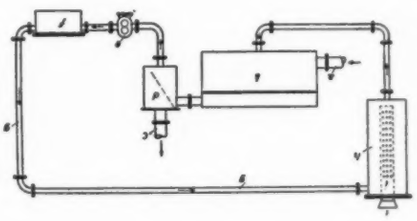
Gas Pipe Line Corrosion in California.—J. C. Albright in PETROL. ENG., vol. 6 (1935), No. 5, pp. 36–38.

Certain natural gas lines in California are beginning to show corrosion, due to the action of hydrogen sulphide, from which the natural gas of this area has heretofore been generally free. At present corrosion seems to be correlated with high pressures, none being observed where the line pressure is less than 75 lbs. per sq. inch, and is generally most noticeable within a few miles of the compressor stations.

As regards corrective measures, it has been definitely determined that if the gas is dehumidified before admission to the transmission lines the chemical reactions leading up to corrosion will be largely prevented. Various methods for freeing the gas from moisture are under consideration by the Pacific Coast Gas Association; these methods contemplate the use of silica gel, or precipitation of the moisture by refrigerating the gas; a plant operating by the latter method has been in use for nearly a year, but as yet the data are not available.

De-Sulphurizing Gas.—A. Thau, in CHEM. ZEIT., vol. 59 (1935), No. 19, pp. 193–195.

A new wet desulphurizing process for gas has been proposed by Rostin and has been found to be quite satisfactory in practice, especially in coal gas works. The desulphurizing solution is prepared by treating copper oxide with ammonia water to obtain a solution containing about 1 percent copper. This solution is employed in the desulphurizing apparatus represented in the accompanying diagram.



The gas, which has been freed from condensible substances, enters by the tube *a* into the washer *b* filled with the wash solution. The interior of *b* is provided with baffles so that liquid and gas make intimate contact; meanwhile a continuous current of copper solution is entering the washer from the vessel *h*. The copper sulphide produced by the reaction takes the form of a foam and passes along with the gas and the excess of solution into the separator *d*, where the purified gas escapes through pipe *c* while the foamy liquid goes through pump *e* to the filter *f*; here the copper sulphide is separated; the filtrate returns through pipe *g* to the vessel *h* where it receives an addition of ammonia which dissolves fresh copper from oxide kept in the basket *i*, thus completing the cycle. The copper sulphide recovered in the filter may be roasted and converted into oxide for re-use.

Notes on Absorption.—A. Newton, in JOUR. INST. PETROL. TECHNOLOGISTS, vol. 21 (1934), No. 136, pp. 75–88.

Two absorption processes are in general use for recovering gasoline from hydrocarbon gases,—charcoal and oil absorption. In the first of these processes the gasoline constituents of the hydrocarbon gas are adsorbed on the surface of charcoal particles, from which they may later be expelled by heat. When completely saturated a good charcoal can hold as much as 35 percent of its weight of gasoline, but in practice the average saturation of a charge does not exceed 20 percent. The life of the charcoal depends on the type of gas being processed, deterioration being caused by sulphur compounds and highly unsaturated hydrocarbons. In the presence of oxygen, sulphur also has a deteriorating effect. In the recovery of natural gasoline the charcoal consumption is 1 lb. per 1,000 lbs. of product, but this increases to 3 lbs. per 1,000 when appreciable quantities of sulphur are present. The charcoal process is best adapted to gases containing 1 gal. gasoline per 1,000 cu. ft., and is to be preferred to oil absorption for very dry gases. It also has an advantage over oil in that the valuable constituents can be more sharply separated from constituents lighter than n-butane.

In the absorption process the gasoline constituents are dissolved out of the gas stream and recovered by a subsequent distillation. The two requirements of an ideal absorption oil are a low molecular weight and a high specific gravity—properties which are not easy to find together. As a workable compromise a medium absorption oil should have i.b.p. 400° F., f.b.p. 600° F., sp. gr. 0.83–0.84 and mol. wt. 180–220; other requirements are low tendency to emulsify with water and resistance to sludging. Oil absorption of natural gas is a comparatively simple matter, but refinery gas is a different proposition on account of the larger gasoline content, the presence of air, hydrogen sulphide and mercaptans. In this case it is not practicable to use a higher compression than about 30 lbs. gauge. Another major source of trouble is corrosion by sulphur compounds. The most economical method of getting rid of the sulphur compounds prior to absorption is by washing with water, using as high a pressure as possible.

Asphalt and Tar

Measuring the Susceptibility of Asphalt to Temperature Changes. A. Holmes, J. O. Collins, and W. C. Childs, before Am. Chem. Soc., New York meeting, Apr., 1935.

The need for some suitable means of expressing the change in consistency of asphalts over the wide range of temperature usually encountered in actual service is demonstrated. While no single factor has been developed which will adequately serve to measure the temperature susceptibility over the entire desired range of conditions, three methods are suggested which can be used in conjunction with one another for this purpose. The softening point-penetration index indicates the susceptibility over a narrow range of normal atmospheric temperatures, the ratio of the penetration at 77° F. to the penetration at 32° F. at subnormal, and the fluidity index at elevated temperatures.

Oxygen Absorption Tests on the Constituents of Asphalt. Robert R. Thurston and Edwin C. Knowles, before Am. Chem. Soc., New York meeting, Apr., 1935.

Soft and air-blown Mexican asphalt, Gilsonite, and other asphalts were examined

and groups of constituents separated, such as asphaltous acids, asphaltenes, petroleum resins, asphaltic resins, and oils. The original asphalts and the constituents of soft Mexican asphalt were subjected to treatment with oxygen in a closed system at 200° C. and a pressure of 2–3 mm. of xylene. The volume of oxygen absorbed was measured and the distribution of it in the products of the reaction determined. It was found that the solid constituents, the asphaltenes, oxidized most readily and the oils were more resistant. The effect of oxygen on the properties of the constituents is discussed.

Bitumen Dispersions in Road Construction. A. van der Werth in ASPHALT UND TEER, Vol. 34 (1934), pp. 1016–1019; 1037–1038.

Bitumens for road construction are prepared in two forms: as suspensions in water without emulsifiers, and as true emulsions. The suspensions are prepared by "homologizing" a mixture of bitumen and water in a colloid mill. The emulsions are made with the assistance of soap, sulphonates and other emulsifying assistants. This paper gives a summary of a large number of German patents on the subject.

Petroleum Refining

Heat Insulation of a Petroleum Rectifying Column.—Otto Krebs, in OEL UND KOHLE, vol. 11 (1935), No. 11, pp. 186–189.

An exact measurement was made of the heat lost by an uninsulated rectifying column. In quiet air at 20° C. the loss amounted to about 5 percent; an equation is given for computing heat losses when the air at different temperatures is moving at different velocities. The general conclusion is that good heat insulation is advantageous.

Corrosion Tests in Various Refinery Services.—J. E. Pollock, E. Camp and W. R. Hicks before Am. Inst. Mining and Metallurgical Engineers, Feb., 1935.

Through the cooperation of manufacturers of special metals and alloys the authors have been able to make a great series of tests and to collect a large volume of data on the resistance of materials under the most diverse refinery conditions. This data should be useful to designers of refinery equipment.

Automatic Control Appliances in the Refinery.—John W. Thompson, in NATL. PETROL. NEWS, vol. 27 (1935), No. 13, pp. 26–30.

A survey was made of a number of oil refineries to ascertain the most usual employments in the refining industry for automatic appliances for the control of temperature, pressure, flow and liquid level. It was found that there was general agreement on the necessity for automatic control at certain vital points in the refining process, as top-of-tower temperature, charging rate, still-outlet temperature and bottoms level. Aside from these points, automatic control devices find wide and varied use, depending on the type of plant. In some cases flow controllers rather than temperature controllers are relied on. Some two dozen separate operations are listed as controlled automatically, and instances are given of comparison of manual control with automatic control. It seems to be the consensus of refiners that automatic control is especially effective in coming on streams from a cold start; in such cases much time and trouble are saved. In a large and well managed refinery one man is kept busy inspecting, cleaning and repairing the numerous control and recording instruments in use.

Materials Used in Oil Refinery Pumps.—A. E. Harnsberger, before Am. Inst. Mining and Metallurgical Engineers, Feb., 1935.

In this compact paper the refinery engineer's attention is directed to the most important considerations affecting the choice of materials entering into construction of refinery pumps.

In reviewing the material requirements of refinery pumps, every definite need of alloy steel and iron parts is disclosed. The only thing that restricts their use is their high cost. High costs cannot be attributed to excess profits but to lack of volume of any one alloy. Pump manufacturers should survey the entire chemical industry and determine whether the bulk of the conditions cannot be met by a few alloys that can be produced in larger quantities at lower costs. As costs lower, a still broader field of application will be found in the less corrosive services.

Composition of Straight-Run Pennsylvania Gasoline. IV. Fractionation of Straight-Run Gasoline. C. O. Tongberg, D. Quiggle, and M. R. Fenske, before Am. Chem. Soc., New York meeting, Apr., 1935.

Pennsylvania, Michigan straight-run gasolines, and Pennsylvania natural gasoline have been fractionated in a 50-gallon thermosiphon-type still equipped with a packed aluminum column. The gasolines were separated into fractions and the wide variations in octane number, refractive index, and boiling range noted and compared. The complexity of the Pennsylvania gasoline was marked in comparison with Michigan.

The narrow boiling range fractions were blended so as to produce a gasoline of higher octane rating than the original, the remaining fractions being suitable as Diesel fuel and solvents.

The Production of Gasoline by Polymerization of Olefins.—C. R. Wagner, before Am. Chem. Soc., New York meeting, Apr., 1935.

Gases from low pressure vapor phase cracking containing 20 to 24 percent of ethylene, 13 to 18 percent of propylene, and 6 to 10 percent of unsaturates in the 4-carbon group were polymerized to liquid products by heat and pressure in the absence of catalysts.

On a once-through basis 1.7 gallons of gasoline per thousand cubic feet were obtained operating at 950° F. and 800 pounds pressure; the yield was increased to 3.0 gallons by recirculating the gas derived from stabilizing the liquid products. The yields were improved in a commercial unit to 3.25 gallons. By processing gas from stabilizing vapor phase cracked distillates, 9.0 gallons were obtained. By operating at low pressure and 1200° to 1300° F. the liquid products were mostly aromatic.

Gasoline from Cracking Still Gases.—V. N. Ipatieff, B. B. Corson, and Gustav Egloff, before Am. Chem. Soc., New York meeting, Apr., 1935.

A catalytic process has been developed for the conversion of olefins into liquid motor fuel. The solid catalyst is rugged and catalytically active. It is not poisoned by hydrogen sulfide, carbon monoxide, and other substances occurring in refinery gases.

A number of typical gases from cracking have been processed by this method. The conversion of the olefins into liquid polymer was of the order of 80–95 percent. The yields of gasoline for 1,000 cubic feet of gas ranged from 2 to 15 gallons, depending on the olefin content of the gas.

The liquid polymer consists of monoolefins. It boils within the gasoline range and has an octane number according to the C.F.R. motor method of 80–85.

Petroleum Chemistry

Structure of Liquids and Mechanism of Viscosity.—W. K. Lewis and Lombard Squires in REFINER, vol. 13 (1934), No. 12, pp. 448–454.

This paper is an attempt to furnish the technical man with a qualitative understanding of the properties of liquids as related to the structure of the liquid state and the character of the forces that operate to maintain it. A qualitative explanation is given of the influence of molecular weight and molecular structure on volatility and boiling point, on liquid density and viscosity. Modern knowledge of the properties of non-homogenous liquids, consisting of mixtures of large, chain-like molecules, with ordinary liquids makes it possible to prepare liquids of abnormally low viscosity-temperature coefficients relative to their viscosities. Mixtures of this type hold promise of developing extreme importance in the field of hydrocarbon lubricants. (In other words the compounder of efficient lubricants must be well informed on the molecular structures of his oils.)

Separation of a Dimethylcyclohexane Fraction from an Oklahoma Petroleum.—R. T. Leslie, before Am. Chem. Soc., New York meeting, Apr., 1935.

A practically constant-boiling and constant-freezing material with an empirical formula of a monocyclic naphthene hydrocarbon was isolated from a fraction of an Oklahoma petroleum boiling at approximately 119° to 121° C. For the purpose of identifying the sample from petroleum, pure *m*- and *p*-xylene were hydrogenated and the mixture of products which were obtained (probably cis and

transforms of the corresponding naphthenes) were purified by cyrstallization. The behavior of the refractive indices and freezing points of the hydrogenated products on repeated fractional crystallizations indicated that the naphthene from petroleum was probably chiefly *m*-dimethylcyclohexane. The infrared spectrogram of the product from petroleum showed that it was composed of cyclohexanes. Comparison of its spectrogram with those of the hydrogenated *m*- and *p*-xylenes indicated that it contained both the *m*- and *p*-dimethylcyclohexanes.

Photomicrographs showed distinct eutectic structures with excesses of one crystalline form visible in both synthetic products. The material from petroleum showed the presence of at least two crystalline forms, one of which melted at a higher temperature than the other. The cooling curves also indicated the presence of more than one crystal form. It is possible that the material isolated was an eutectic of isomers with a slight excess of one.

It is estimated that the octonaphthene was present in the original crude oil to the extent of not less than 0.15 percent.

Pyrolysis and Polymerization of Gaseous Paraffins and Olefins.—F. W. Sullivan, Jr., R. F. Ruthruff, and W. E. Kuentzel, before Am. Chem. Soc., New York meeting, Apr., 1935.

The pyrolysis of ethane, propane, butane, and isobutane in KA2S coils is reviewed. The data show that a 75 to 100 percent volume yield of olefins is obtained under optimum conditions. As paraffins higher than ethane decompose largely with the formation of an olefin and a lower paraffin, the weight yield of olefins is less than the volume yield, averaging 60 percent. Results obtained in the polymerization of pure ethylene and pure propylene are reviewed. These polymerization runs were made at 500 to 3,000 pounds pressure and under optimum conditions about 75 percent of the olefins charged were converted to liquid.

Oil-field Water Analysis.—W. R. Wiggins and C. E. Wood, in JOUR. INST. PETROL. TECHNOLOGISTS, vol. 21 (1935), No. 136, pp. 105–119.

The composition of water encountered or used in oil-field operations is of importance from numerous standpoints, including correlation studies and practical operations. In this series of studies the authors have assembled methods for making these analyses; the present paper gives a detailed exposition of the zinc uranyl-acetate method for estimating sodium.

Determination of Gaseous Olefins or Hydrogen by Catalytic Hydrogenation.—Wallace A. McMillan, Howard A. Cole, and A. V. Ritchie, before Am. Chem. Soc., New York meeting, Apr., 1935.

A new method for the quantitative determination of gaseous olefins by catalytic hydrogenation has been developed which gives consistent reproducible results accurate to a few tenths of a percent in a time comparable with any liquid reagent method.

For the determination of olefins an amount of hydrogen equal to approximately twice the volume of olefins present is added to the sample and the contraction in volume of the mixture after passage over the catalyst is measured. The contraction equals the volume of olefins present. The method may also be applied to the determination of acetylene of diolefins when the contraction is twice the amount present.

The method is equally effective for the determination of hydrogen, though the catalyst must be heated to 185°–195° C. if carbon monoxide is present.

Light Effect on Color Stability of Gasoline.—J. C. Morrell, Wayne Benedict, and Gustav Egloff, before Am. Chem. Soc., New York meeting, Apr., 1935.

The effects of light on the color stability of Midcontinent gasolines containing sulfur and *n*-propyldisulfide were studied using oxidizing, reducing, and inert atmospheres. Color, haze, peroxides, acids, and gum formed in oxidizing atmospheres. Sulfur increased color, gum, and haze formation but the disulfide caused only color and haze formation. Except in gasolines containing sulfur, in which some color and gum formed, no depreciation occurred upon exposure in non-oxidizing atmospheres. Color, haze, peroxide, acid and gum formation resulted from photochemical oxidation reactions. The presence of oxygen is necessary for production of haze, peroxides, or acids. Haze particles contained sulfuric acid and organic matter.

The Oxidation of White Oils.—Ralph W. Dornte, before Am. Chem. Soc., New York meeting, Apr., 1935.

It has been shown that the rate of oxygen absorption by white oils can be used as a method of determining resistance to oxidation. The rate of the oxidation can be represented accurately by a simple empirical rate law. The temperature coefficient of the oxidation reaction has been determined and shown to be an important characteristic of the oil. Certain products of the oxidation (peroxides, acids, and water) follow the same general rate law as the oxygen absorption. The results show that the oxidation of white oils is an autocatalytic process involving a chain mechanism whose rate determining step is probably a dissociation reaction.

Relations of Thermal Reactions of Gaseous Paraffins, Olefins, Acetylenes, and Cycloparaffins.—Gustav Egloff and Edith Wilson, before Am. Chem. Soc., New York meeting, Apr., 1935.

Mechanisms for the thermal reactions of gaseous hydrocarbons—paraffins, olefins, acetylenes, and cycloparaffins—are considered in detail on the basis of activation energies for the primary and secondary reactions. These lead to an explanation of the decomposition products over the whole temperature range. The thermal reactions of ethylene are taken as the key to the reactions of all other gaseous hydrocarbons since above a certain temperature the reaction products of any hyrdocarbon are essentially those of ethylene at that temperature. The complete story of the thermal reactions for these hydrocarbons is obtained by consideration of the reactions occurring below 750°. These are characterized by differences due to the nature and stability of the particular molecule.

Isolation of Ethylcyclohexane from an Oklahoma Petroleum.—F. W. Rose, Jr., and Joseph D. White, before Am. Chem. Soc., New York meeting, Apr., 1935.

Fractionation of that portion of an Oklahoma petroleum which normally boils between 131° and 133° C. has resulted in the isolation for the first time of a naphthene identified as ethylcyclohexane. The method employed in its separation is systematic fractional distillation, distillation with glacial acetic acid, and fractional crystallization from a solution in liquid propane and methane.

A sample of ethylcyclohexane of considerable purity has been synthesized and compared with that isolated from petroleum in respect to the following physical properties: boiling point, freezing point, refractive index, density, molecular weight, and infra-red spectrum. The critical solution temperature in aniline and the carbon-hydrogen ratio of the petroleum sample have been determined. The purity of the isolated sample is estimated to be about 95 percent. The total content in petroleum has not been determined but does not exceed 0.2 percent.

Catalytic Polymerization of Gaseous Olefins by Liquid Phosphoric Acid.—V. N. Ipatieff, before Am. Chem. Soc., New York meeting, Apr., 1935.

Ethylene, propylene, and the isomeric butylenes have been polymerized by phosphoric acid to liquid mono-olefins. The catalytic action of phosphoric acid depends upon its ability to form esters which serve as intermediates in the formation of the polymers. The process has actually been carried out in two steps as postulated by this hypothesis. Various metallic salts and oxides promote the catalytic action of phosphoric acid. The various olefins can be selectively polymerized in the presence of each other. Under certain conditions naphthenes are formed due to cyclization of olefins and also paraffinic and aromatic hydrocarbons, due to hydrogenation-dehydrogenation reactions.

Octane Number Improvement in Naphtha Reforming as a Function of the Time-Temperature Integral.—S. D. Turner and E. J. LeRoi, before Am. Chem. Soc., New York meeting, Apr., 1935.

A correlation of plant cracking data has been effected that satisfactorily gives the octane number obtainable in reforming naphtha in terms of the original octane of the charge and the amount of cracking to which it is subjected. The amount of cracking is expressed in terms of equivalent seconds at 900° F., which are derivable from, or convertible to, an actual time-temperature curve on the assumption that the cracking rate doubles with a rise in temperature of 25° F.

By mathematical treatment the octane improvement of naphtha can be predicted. For purposes of still design the method may be worked backwards.

The Hydrocarbons of the Gamma Sulphonic Acids.—S. v. Pilat and W. Szankowski, in PETROLEUM, vol. 31 (1935), No. 10, pp. 1–6.

This investigation was undertaken to obtain more information regarding those sulpho acids that arise when lubricating oils are refined

with concentrated sulphuric acid, and are obtained in the form of water-soluble calcium salts from the acid sludge by various patented processes. It was found that the best means of obtaining the free hydrocarbons was to split off the sulpho group with phosphoric acid.

The special characteristics of this hydrocarbon group are: a remarkably high refractive index, a specific gravity always greater than 1, a very steep temperature-viscosity curve, and a ratio of hydrogen to carbon of about1:1; this ratio remains constant with increasing molecular weight, indicating that these compounds belong to a homologous series; their resistance to oxidizing agents suggests that they are ring compounds.

Cracking and Polymerization of Low Molecular Weight Hydrocarbons. Per K. Frolich and Peter J. Wiezevich, before Am. Chem. Soc., New York meeting, Apr., 1935.

The thermal decomposition of methane, ethane, propane, *n*-butane, the corresponding olefins, and acetylene is discussed from the point of view of maximum olefin and liquid fuel production. Propane has been studied in greatest detail. (1) Simultaneous cracking and polymerization at atmospheric pressure, (2) cracking at atmospheric pressure for maximum unsaturates followed by polymerization at high pressure and lower temperature, (3) an intermediate step introduced in (2) to remove hydrogen by selective oxidation, are discussed.

The removal of hydrogen increased the yield of liquid products almost fourfold. The introduction of air into heated olefins initiates polymerization at much lower temperatures and pressures.

Kinetics of Ethylene Polymerization. II.—H. H. Storch, before Am. Chem. Soc., New York meeting, Apr., 1935.

The addition of ethylmercaptan in small amounts (about 0.1 percent) to ethylene completely destroys the "trace" catalysis by the minute amounts of oxygen present in "pure" ethylene. The heat of activation of the ethylene polymerization in the presence of 0.1 percent of C_2H_5SH is 43,500 cals., and the collision efficiency is about 4 percent. An induction period still exists even with mercaptan-treated ethylene, but it is appreciably shorter than that with untreated ethylene. Small amounts of propylene and butylene do not change appreciably the rate of ethylene polymerization. About 0.01 percent of nitrous oxide increases the rate several hundred percent, and appears to be almost as efficient as oxygen in this respect.

The Polymerization of Propylene. Preliminary paper.—Frank C. Whitmore and Robert F. Marschner, before Am. Chem. Soc., New York meeting, Apr., 1935.

The work of Gayer (Ind. Eng. Chem., 25, 1122, 1933) has been confirmed in great detail. Polymerization of propylene in presence of the Gayer catalyst (artificial alumina-on-silica), at about 350° C. (about 200° below the cracking temperature of propylene as determined by Hurd) yields, in order of abundance, hexenes, heptenes, pentenes, nonenes, and octenes. The presence of the heptenes, pentenes, and octenes has been definitely settled. The mixtures are being studied to determine the structure of the individual olefins. Trimethylethylene has been isolated and identified by conversion to its dibromide, to methyl isopropyl ketone, and the 2,4-dinitrophenylhydrazone of the latter. The highest boiling hexene has been proved to be tetramethylethylene by conversion to its characteristically high melting dibromide. The work is being continued. The results should be valuable in studying the mechanism of polymerization.

The Formation of Alicyclic Hydrocarbons from Free Radicals.—F. O. Rice and O. L. Polly, before Am. Chem. Soc., New York meeting, Apr., 1935.

The cracking of straight-chain hydrocarbons of high molecular weight seems to be accompanied in greater or less degree by the formation of naphthenic hydrocarbons. There are several mechanisms through which this may occur, but this paper reviews the evidence and discusses in detail only one of these mechanisms, namely, the rupture of the original high molecular weight hydrocarbon into two free radicals, which then decompose successively into cycloparaffins and smaller free radicals. A number of examples of such decomposition are offered.

A number of alternative equations are offered in which the hydrocarbon decomposes into an olefin and a free radical. The relative extent to which each mechanism is followed is presumably dependent upon the conditions.

Pyrolysis of Gaseous Paraffin Hydrocarbons.—Hans Tropsch and Gustav Egloff, before Am. Chem. Soc., New York meeting, Apr., 1935.

The pyrolysis of gaseous paraffin hydrocarbons at temperatures of 1100° to 1400° C., at 50 mm. mercury pressure was investigated. Varying the time of contact, at first the formation of ethylene and later that of acetylene took place, while ethylene yields decreased after they reached a maximum. At 1100° C. propane and butane formed a maximum of 15 and 22 volumes of propylene per 100 volumes of hydrocarbon, respectively.

The maximum yields of acetylene from ethane and propane at 1400° C. were 53 and 76 volumes per 100 volumes of hydrocarbon with a contact time of 6/1000 second. Methane required 10–20 times longer treating at 1400° C. to form maximum acetylene. The maximum yield of ethylene from ethane, propane, and *n*-butane is discussed.

Petroleum Physics

A New Basic Principle in the Design of Fractionating, Absorbing, and Other Countercurrent Fluid Reacting Equipment.—Walter J. Polbielniak, before Am. Chem. Soc., New York meeting, Apr., 1935.

The term "countercurrent fluid reacting" is broadly used to include not only distillation and gas scrubbing but also extended countercurrent contact between a liquid and a gas phase or between two immiscible liquid phases. Solvent extraction, evaporation of water in a stream of air, chemical reactions, etc., are included.

The paper discloses a new general principle of countercurrent fluid reacting apparatus design, whereby controlled centrifugal force is substituted for gravitational force. The use of high centrifugal force permits of great compactness of apparatus and much higher vapor and liquid velocities, thereby increasing the capacities per unit cross-sectional area of passage. Great intimacy of contact is effected and pressure drop through the apparatus may be small or negative.

Separation of Petroleum Hydrocarbons with Silica Gel. A Simple Method for the Quantitative Removal of the Aromatic Components from the Naphtha Distillate of Petroleum by Adsorption on Silica Gel.—Beveridge J. Mair and Joseph D. White, before Am. Chem. Soc., New York meeting, Apr., 1935.

The fractionation, by filtration through columns of silica gel, of a number of binary mixtures of pure hydrocarbons boiling from 80° to 175° C. is reported. The results of these experiments show that (a) aromatic and olefin hydrocarbons can be completely removed from paraffin and naphthene hydrocarbons; (b) a small but definite separation of naphthene from paraffin hydrocarbons occurs, the naphthenes tending to be adsorbed by the gel in preference to the paraffins; (c) a slight separation of *n* paraffin hydrocarbons of different molecular weight occurs, the paraffin of low molecular weight being adsorbed in preference to that of high molecular weight.

A simple laboratory method, of use for the complete removal of aromatic and olefin hydrocarbons from the naphtha distillate of petroleum, is described.

Characterization of Petroleum Fractions.—K. M. Watson, E. F. Nelson, and George B. Murphy, before Am. Chem. Soc., New York meeting, Apr., 1935.

Empirically developed charts are presented interrelating the U. O. P. characterization factor with specific gravities, boiling points, viscosities, aniline points, viscosity index, and hydrogen contents of petroleum fractions. If for any particular stock two of these properties are known, the others may be more or less satisfactorily approximated. The most satisfactory correlations are based on determination of specific gravity and either average boiling point or viscosity at 210° F. These determinations permit prediction of the other properties with fair approximation for use in engineering problems.

Apparatus for Measuring the Boiling Points of Lubricating Oils and Other Compounds of High Molecular Weight at Reduced Pressures.—S. T. Schicken, before Am. Chem. Soc., New York meeting, Apr., 1935.

This paper describes an apparatus suitable for determining accurately the boiling point of lubricating oils and other compounds of high molecular weight at temperatures and pressures below their decomposition points. The temperatures are determined by means of three thermocouples located at different

heights in the vapor column, which give by their differences in temperature some indication of the purity of the sample, the readings of the three thermocouples being identical for a pure substance. The pressures are determined with a McLeod gage.

Data are reported for pure di-*n*-butyl phthalate, for mixtures of di-*n*-butyl phthalate with 6.82, 10.62, and 18.75 mole percent of tri-ortho-cresyl phosphate, and for two lubricating oil fractions obtained from successive distillations.

THE MECHANISM OF THERMAL DECOMPOSITION OF THE PARAFFINS.—Louis S. Kassel, before Am. Chem. Soc., New York meeting, Apr., 1935.

The detailed kinetic consequences of the F. O. Rice free radical chain mechanism applied to the thermal decompositions of ethane, propane, and butane are investigated. It is shown that for butane and higher hydrocarbons the composition of the products must depend upon the pressure, and that in certain pressure ranges the reaction will be of an order higher than the first. These relations provide a rather direct means of testing the applicability of the Rice mechanism to hydrocarbon decompositions.

A RAPID PRECISION VISCOMETER.—Ogden FitzSimons, before Am. Chem. Soc., New York meeting, Apr., 1935.

The accuracy of the Saybolt viscometer is compared on a theoretical basis with viscometers whose efflux time is linear with viscosity. The possible errors resulting from the use of Saybolt data to obtain the viscosity index of light oils are discussed. The suspended level viscometer of Ubbelohde is modified so as to allow the use of two capillary tubes of different bores and the whole mounted in a vapor bath. The instrument is characterized by more rapid operation than that afforded by the Saybolt instrument, and the high inherent accuracy of capillary viscometers.

EFFECTIVENESS OF LEAD TETRAETHYL IN INCREASING THE CRITICAL COMPRESSION RATIO OF SOME INDIVIDUAL HYDROCARBONS.—John M. Campbell, Frank K. Signaigo, Wheeler G. Lovell, and T. A. Boyd, before Am. Chem. Soc., New York meeting, Apr., 1935.

Quantitative measurements of the specific antiknock effect of lead tetraethyl in 62 individual hydrocarbons were made by finding the increase in critical compression ratio, in a single-cylinder variable-compression engine, made possible by the addition of lead tetraethyl in a concentration of 1.0 cc. per gallon. Upon this basis there are as great as twenty-fold variations in the effectiveness of lead tetraethyl in suppressing knock in different hydrocarbons. Certain general relationships between hydrocarbon structure and susceptibility to lead, which appear to be consistent within the scope of this work, are described.

SPONTANEOUS IGNITION OF PETROLEUM FRACTIONS.—P. J. Wiezlvich, J. M. Whitley, and L. B. Turner, in IND. ENG. CHEM., vol. 27 (1935), No. 2, pp. 152–155.

Data on the spontaneous ignition temperatures of petroleum products are of value in determining explosion and fire hazards in processes involving such products. The authors of this paper, working in the laboratories of the Standard Oil Development Co., have determined the spontaneous or auto-ignition temperatures of various fractions from different crude oils.

A minimum value is noted in the kerosene and fuel oil range, while a rapid rise takes place in the lubricating oil range. When compared according to boiling point, both Pennsylvania and Colombian crude fractions show similar spontaneous ignition temperature curves.

Experiments with heated open plates and closed containers heated with oxygen under pressure are described. Oxygen is exceedingly dangerous in many cases, leading to detonations as well as the burning of metal lines. The presence of nitrogen, steam, or other similar diluents greatly reduces the explosion hazard.

The spontaneous ignition temperature is a relatively simple method for indicating the structure of hydrocarbons. For the same number of carbon atoms, the decrease in spontaneous ignition temperature falls roughly in the order: aromatics, alkylated aromatics, naphthenes, alkylated napthenes, straight-chain paraffins, branched-chain paraffins, and unsaturated aliphatics. Some results are given below:

Spontaneous Ignition Temperatures (in Air) of Fractions from Crude Oils

Av. B.P. of Fraction [a] ° F.	A.P.I. Gravity	Viscosity At 100° F. (38° C.) Seconds	Viscosity At 210° F. (99° C.) Seconds	S.I.T. ° F.
Colombian Crude				
448	37.5	.....	....	505
541	31.5	.....	....	505
632	27.7	.....	....	662
753	24.0	174.5	....	745
786	23.1	287.5	....	765
815	21.9	451	53.1	780
...	20.9	996	67.7	795
Pennsylvania Crude				
441	44.8	.....	....	480
520	41.6	.....	....	480
595	39.1	.....	....	670
685	35.6	60	....	687
726	34.8	70	....	715
745	33.8	90	....	730
...	32.5	125	41	755
...	30.4	278	51.2	785

[a] Reduced to atmospheric pressure.

CHLORINATED PARAFFIN.—R. Strauss, in OEL UND KOHLE, vol. 11 (1935), No. 5, pp. 83–84.

In a series of experiments it was found that soft paraffin wax (M.P. 40/42° C.) could be made to take up as much as 44 percent of chlorine; the chlorparaffins thus obtained are mostly liquids, and have the noteworthy property of mixing with castor oil, which does not mix with petroleum oils. The chlorine in the chlorinated product may be substituted by hydroxyl or ammonia to give a variety of interesting products.

PROLONGING THE LIFE OF LUBRICATING OILS.—J. Mardles in CENT. ZUCKERIND., vol. 43 (1935), No. 11, p. 213.

Reference is made to investigations at the British Royal Aircraft Establishment on the oxidation of lubricating oils in use. As is generally known, certain metals, especially copper accelerate the absorption of oxygen by lubricating oils. The author has found that other metals as iron, manganese, silver and vanadium have an action similar to that of copper; also, in less degree, gold, mercury, chromium, bismuth, and antimony. The only metal that seems to act against the oxidation of a lubricating oil is tin, and the presence of this metal is thus a means of prolonging the life of the lubricant. Among the tin compounds that have been found usable in this connection are certain tin salts of fatty acids, tin naphthenate, tin phenolate, tin tetraphenyl, and tin naphthyl. Addition of these substances is advantageous when the lubricating oil is heated above 200° C. in presence of air, as in the cylinders of internal combustion motors.

LABORATORY EXPERIENCE IN THE INVESTIGATION OF EMULSIONS FOR ROAD BUILDING.—Herbert Kleinert, in ASPHALT UND TEER —Strassenbautechnik, vol. 35 (1935), No. 10, pp. 194–200.

The author gives a summary of six years experience with the official methods of laboratory examination of emulsions used as binders in road construction and in many cases is able to show how these methods may be improved. The subjects considered are: Sampling, reaction, sieve test, viscosity, microscopic appearance, water determination, estimation of bitumen, frost resistance of emulsions, kneading quality of emulsions, specific adhesiveness to various filling materials, and stability; in this latter connection the English "lability test" is not regarded as having been well established.

TEST FOR MOTOR OIL STABILITY.—Arthur Gazar, in PETROLEUM WORLD (Calif.), vol. 32 (1935), No. 2, pp. 23–24.

A test for motor oil stability devised by the research department of the Associated Oil Co. is as follows: A 20-gram sample of the oil is placed in a 200-cc. beaker, covered by a watch glass, and heated 100 hours in an oil bath at 150° C. (302° F.). The beaker is then cooled and the oil washed with 800-cc. A.S.T.M. ether into a 100-cc. Erlenmeyer flask and allowed to stand 24 hours. The asphaltic precipitate is filtered through a Gooch, washed, and taken

up with hot benzol, and if necessary with hot chloroform. The combined asphaltic solution is evaporated to dryness and weighed.

It has been found that an oil that will stand this test without formation of deposits is extemely stable and will give excellent service in any automotive equipment. It has been used by the Associated Oil Co. for a number of years.

Iron Carbonyl as an Anti-Knock Compound.—Michael J. Leahy, in REFINER, vol. 14 (1935), No. 2, pp. 82–84.

Iron carbonyl would make an efficient antidetonant for gasoline if it could be made insensitive to light. Many inventors have tried their hands on the problem, and though numerous patents have been taken out on compounds that are claimed to confer insensitivity to light, none of these processes seem to be in commercial use. It is suggested that refiners contemplating use of iron carbonyl as a stabilizer should first make a thorough study of the existing literature and patents, of which the author gives a lengthy list.

Petroleum Economics

Three Hundred Years of Oil. A Story of Conservation. Gustav Egloff, before Am. Chem. Soc., New York meeting, Apr., 1935.

Conservation has been the keynote of the oil industry since the beginning. Oil companies have invested in research and development at the expense of profits, forced thereto by insistent demand of the automobile industry for more and better gasoline and lubricating oil. If refiners had had to meet the 1934 gasoline requirements with refining methods in use in 1917, it would have required 973,000,000 barrels more crude oil than was actually refined. Proportionate savings have also been effected in lubricating oil manufacture, natural gasoline recovery, and crude oil production.

British Empire Oil Supplies in War.—Andrew Agnew, in PETROL. TIMES, vol. 33 (1935), No. 837, pp. 115–118.

There are three alternative methods whereby Great Britain may secure a supply of oil in war-time: Home production from native raw materials; to store oil for emergency; to rely on ample tankers and a strong navy. But Britain has no native oil; and under the best possible conditions the processes of low temperature carbonization and hydrogenization can supply no more than a small portion of the four million tons needed annually by the country—except at an excessively high cost. The alternative of storing oil is feasible and should not be too much neglected, but will be of value only in connection with ample refining capacity; however, the creation of a great refining industry as a safeguard in the event of war is not at present considered advisable for Britain, notwithstanding what it may be for France and Italy.

In the author's opinion there remains only the third alternative; possession of an adequate fleet of tankers and bunkering stations, and a navy which could protect them.

Some Aspects of Unit Operation of Oil and Gas Pools and Fields.—Leroy H. Hines, in publication 92727 of U. S. Geol. Survey, 1934.

The author discusses the question of unit operation of petroleum fields from the legal and constitutional standpoints. Heretofore the courts have held oil and gas to be subject to the law of capture, with the well known disastrous results. This ancient and thoroughly mischievous legal principle has now been for all practical purposes set aside in some States by the exercise of the police power to prevent waste of natural resources and to abate nuisances, and the U. S. Supreme Court has upheld the right of States to enforce unit operation for these reasons. The introduction of unit operation throughout the industry is now possible and is urgently advisable. The author reviews the history of oil fields that are being operated as units, and gives model forms for agreements among holders of petroleum properties, with voluminous comments and explanations.

Modifying the Capture Law.—Earl Oliver, before Am. Inst. Mining and Metallurgical Engineers, Feb. 1935.

In this address the purpose is to show first the legal conditions necessary to promote unit operation of oil fields, and second to suggest unitization procedure when those legal conditions are established. The matter hinges on the installation of two legal concepts as integral parts of oil and gas law; a practical substitute for the capture rule, and cooperative ownership control for the individual oil and gas pool. It is emphasized that these aims cannot be crystallized in legislation until the engineers convince legislative bodies that unitization procedure is practicable and will benefit both the consuming public and the property owner. The best form of this proof would be examples of unitization projects that have been developed under principles that the author here sets forth. His proposition is to look around for a few wildcat structures under sympathetic ownership that would be willing to have those structures utilized in the manner of laboratory experiments for development of legal and engineering principles covering such cases. With object lessons of this sort legislative and judicial cooperation should be easy to obtain.

Pipelines

Vulcanized Rubber Coating for Pipe Lines.—L. E. Bredberg, in OIL AND GAS JOUR., vol. 33 (1935), No. 38, p. 14.

A gas company in the Ranger district of west central Texas has laid an experimental pipe line protected against corrosion by a coating of vulcanized rubber ¼ inch thick. If the experiment turns out to be a success it is expected that the method will come into general use in locations where a high rate of corrosion of iron pipe is to be anticipated. At present prices this use of rubber is held not to be prohibitive.

Nomographic Study of Pipe-Line Design.—L. V. W. Clark, Reza Fallah, and A. W. Nash, in JOUR. INST. PETROL. TECHNOLOGISTS, vol. 21 (1935), No. 136, pp. 120–124.

In this paper the authors continue their nomographic studies on pipe-line design; the present contribution deals with brake horse power corresponding to given diameters per mile required to pump the fluid against the frictional resistance only, the static head being considered separately. Three nomographic charts greatly simplify the computations.

Books

Petroleum Production, 1934.—AM. INST. MINING AND METALLURGICAL ENGINEERS, Feb. 1935.

This pamphlet presents brief summaries of operations, production and technical developments in the oil fields of California, Michigan, Mississippi, Ohio, Texas Gulf Coast, Utah, West Virginia, Australia and Mexico.

Geology and Geography: Reports of Committees.—National Research Council, 1933–34, Washington, D. C.

The annual reports on research projects under supervision of the Geology Division of the National Research Council contain observations on many matters of interest to petroleum geologists.

Oil Country Tubular Goods.—Anon, published by Stewarts and Lloyds, Ltd., London, 55 pp. (for free distribution).

This is primarily an abridgment of the latest editions of A.P.I. Specifications 5-A and 5-L giving the essential details in a concise form, with tables giving the complete particulars of the standard oil pipes and joints. Especial attention is given to welded joints, victaulic joints and Johnson couplings.

Russian Oil.—A Selection of Articles reprinted from the PETROLEUM TIMES. 1935.

This is an interesting collection of 20 short articles giving information on various phases of the Russian oil industry. Of particular interest is a paper on "Recent Oil Developments in the U.S.S.R." by Professor L. C. Uren of California.

Volume Correction Chart, by M. G. van Voorhis, published 1935 by NAT. PETROLEUM PUBLISHING CO., Cleveland. 50 cents.

Charts have been prepared for correcting volume of gasoline and other petroleum products for temperature. They are intended to take the place of Bureau of Standards circular No. 154, which is now out of print.

World Oil Production—Official Figures for 1934 and 1935 Revised

All figures furnished direct to WORLD PETROLEUM by Governments, except where otherwise specified

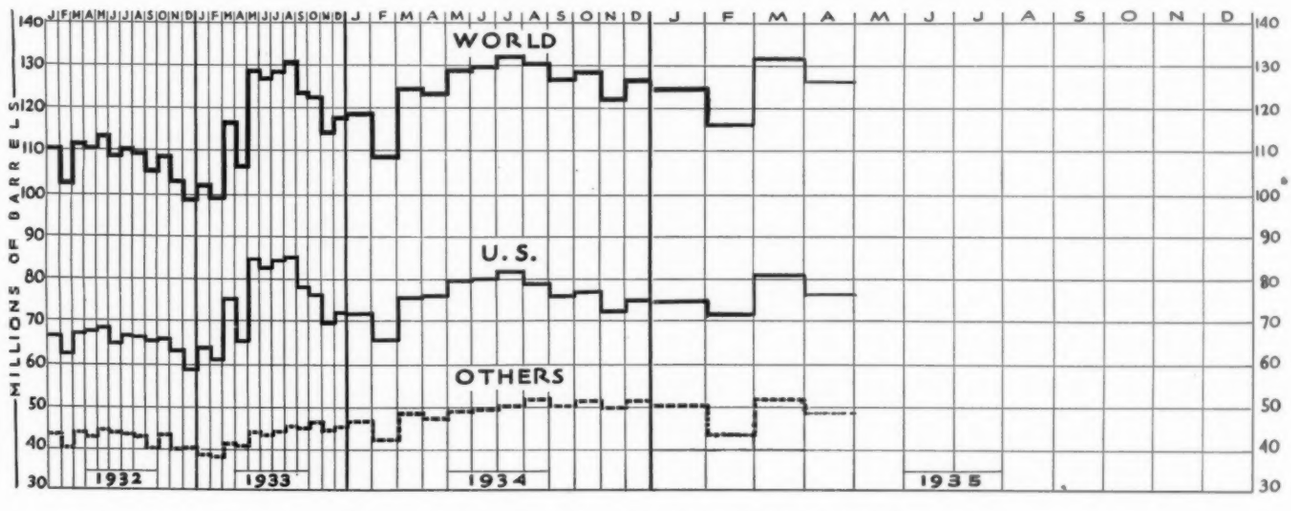
(Figures in U. S. Barrels—Conversion ratio 7 bbl.=1 ton)

Country	May 1934	June 1934	July 1934	August 1934	September 1934	October 1934	November 1934	December 1934	January 1935	February 1935	March 1935	April 1935
United States	79,870,000	80,040,000	81,548,000	79,058,000	75,810,000	76,776,000	72,463,000	74,772,000	78,715,000	72,763,000	81,488,000	76,220,000[1]
Russia	14,315,000	13,966,400	14,297,500	14,287,700	13,924,400	14,260,000	14,388,500	14,638,400	13,358,100	12,704,300	14,139,300	14,058,200
Venezuela	11,768,799	12,500,307	12,193,307	12,505,304	12,381,159	12,591,390	12,274,794	12,420,296	12,818,414	11,287,605	11,703,825	11,869,900
Roumania	5,008,000	5,178,000	5,223,000	5,556,000	5,335,000	5,467,000	5,324,000	5,522,000	5,355,000	4,860,000	5,256,000	5,160,000
Iran[2]	4,648,105	4,401,223	4,577,251	4,886,462	4,955,419	4,499,530	3,725,178	4,049,536	4,410,714	4,109,665	4,879,000	4,088,000
Mexico	2,714,828	2,918,793	3,303,055	3,434,516	3,276,612	3,393,770	3,332,926	3,425,314	2,894,167	2,661,632	3,519,148	3,120,023
Netherland India	3,609,816	3,577,056	3,678,745	3,456,215	3,410,785	3,577,399	3,553,067	3,743,810	3,716,300	2,630,642	3,640,266	3,533,838
Colombia[4]	1,730,095	1,683,691	1,646,739	1,691,314	1,627,632	1,646,293	1,633,654	1,554,172	1,653,647	1,141,696	1,466,821	1,377,299
Argentina	1,029,074	1,096,855	1,077,502	1,210,273	1,258,812	1,271,186	1,283,811	1,173,998	1,114,235	1,107,420	1,260,468	1,410,000[1]
Peru[4]	1,085,192	1,187,030	1,233,804	1,300,253	1,259,901	1,303,554	1,169,826	1,250,247	1,248,465	1,105,508	1,218,852	1,160,942
Trinidad	926,785	947,122	1,008,669	975,697	919,469	906,152	907,655	930,877	915,220	843,619	919,848	899,946
British India	796,208	749,294	785,751	762,959	752,451	779,011	763,091	746,410	700,000[1]	700,000[1]	700,000[1]	700,000[1]
Poland	305,592	304,437	315,861	320,145	311,003	315,000	308,000	308,000	307,000[1]	297,000[1]	309,000[1]	330,000[1]
Sarawak	166,565	158,669	164,206	161,504	155,400	156,800	152,600	158,200	183,300	136,500	152,250	151,067
Japan	126,170	125,202	131,397	129,326	124,870	125,229	119,970	131,059	171,441	151,797	164,174	170,357
Egypt	130,851	132,097	135,156	131,061	124,502	123,235	116,326	115,731	112,147	100,086	113,000[1]	111,000
Ecuador	142,869	158,826	141,474	140,944	136,033	141,079	133,490	140,000	147,315	139,555	151,366	145,212
Canada	117,693	109,021	120,772	114,778	114,242	122,056	113,228	117,113	124,654	111,545	120,537	118,050
Germany[3]	159,103	179,480	208,145	219,961	198,366	227,605	219,485	228,767	287,518	223,153	277,942	240,464
Iraq[5]	100,000	100,000	100,000	100,000	100,000	100,000	357,000	1,054,599	425,000	1,631,000	575,000	556,500
France[1]	46,000	46,000	46,000	46,000	46,000	46,000	46,000	46,000	46,000	46,000	46,000	46,000
Others[1]	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000
Total	128,871,745	129,634,503	132,011,334	130,563,412	126,297,056	127,903,289	122,460,601	126,601,549	128,778,637	118,826,723	132,175,797	125,541,798

[1] Estimate. [2] Anglo-Persian Oil Co. figures revised; fuel oil returned to the ground has been deducted. [3] Thuringia estimated 7,000 bbl.; official figure for Prussia. Russian Sakhalin included with Russia. Japanese Sakhalin included with Japan. [4] International Petroleum Company's figures. [5] Iraq production estimated to November 1934; represented by oil shipments through Tripoli and Haifa starting in November.

Official Crude Oil Production Figures for 1932 to 1935

	Total 1935	Daily Average 1935	Total 1934	Daily Average 1934	Total 1935	Daily Average 1933	Total 1932	Daily Average 1932
United States	309,186,000	2,576,550	909,107,000	2,490,704	898,874,000	2,462,670	785,159,000	2,145,243
Russia	54,259,900	452,165	168,648,700	462,051	149,901,900	407,950	149,719,000	409,070
Venezuela	47,679,744	397,331	142,072,329	389,239	120,882,802	331,186	119,596,512	326,766
Iraq	3,187,500	26,562	71,921,468	6,607	1,200,000	3,288	1,200,000	3,300
Roumania	20,631,000	171,950	62,006,000	169,879	50,971,200	139,647	50,491,205	137,954
Iran	17,487,379	145,728	52,663,782	144,284	49,581,280	135,840	45,122,455	123,285
Mexico	12,194,970	101,624	38,167,022	104,567	33,904,882	92,890	32,802,285	89,624
Netherland India	13,521,046	112,675	42,289,408	115,861	38,512,663	105,516	39,584,027	108,153
Colombia	5,639,463	50,328	17,340,724	47,509	13,157,127	36,047	16,384,956	44,768
Argentina	4,892,123	40,767	14,045,652	39,015	13,759,565	38,232	13,166,900	35,975
Peru	4,733,767	39,448	14,143,959	38,751	13,923,281−	38,146	9,899,266	26,026
Trinidad	3,578,633	29,821	10,894,363	29,847	9,560,039	26,192	10,023,780	27,387
British India	2,800,000	23,333	8,997,399	24,650	8,721,665+	23,893	8,600,312	23,500
Poland	1,243,000	10,358	3,697,617	10,130	3,858,085−	10,570	3,905,230	10,670
Sarawak	623,117	5,192	1,948,044	5,337	2,289,472−	6,273	2,274,043	6,213
Japan	657,769	5,481	1,484,962	4,068	1,377,761	3,827	1,575,333	4,375
Egypt	436,233	3,635	1,479,037	4,052	1,591,495	4,360	1,742,370	4,760
Ecuador	583,448	5,195	1,655,062	4,534	1,622,624−	4,446	1,573,857	4,300
Canada	474,786	3,956	1,418,810	3,887	1,147,825−	3,144	1,054,373	2,880
Germany	1,029,077	8,575	2,266,964	6,211	1,712,823	4,692	1,824,019	4,983
France	184,000	1,533	552,000	1,512	552,000	1,515	552,000	1,508
Bahrein			285,071	781				
Others	300,000	2,500	861,000	2,359	432,000	1,184	432,000	1,180
	505,322,955	4,211,024	1,498,151,433	4,105,058	1,417,534,489	3,884,022	1,296,712,823	3,544,940



World crude oil production in barrels by months, 1932–1935: Ratio of United States crude production to production in all other countries

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The Oil Industries Club of London held a Silver Jubilee Ball at the Park Lane Hotel on May 6 in celebration of the Silver Jubilee of Their Majesties George V and Queen Mary. Some 400 members and guests attended and were received by the President and Mrs. Wigney.

Foreign Oil Legion

JOSEPH PEVSNER, the new chairman of the Soyusnefteexport, was born in the year 1893 in Baku. He was one of the original members of the Board of Soyusneft, which is the chief organisation in the U.S.S.R. for controlling the production of oil. Mr. Pevsner was made chairman of R.O.P. Ltd., London, on 7th January, 1932, and since the end of April last has taken over the chairmanship of Soyusnefteexport, which is the organisation in the U.S.S.R. for exporting all oil products.

Joseph Pevsner

RENÉ BERG of the Société Prémafu of Paris returned to France from the United States on May 27 on the SS. CHAMPLAIN. Mr. Berg had been in the United States from early in April on behalf of his company arranging to represent various American firms in Europe.

JOHN D. BENNETT, formerly of the Bennett Oil Company has been elected to membership in the New York Commodity Exchange specializing in Petroleum Futures. Mr. Bennett is making his office with Munds, Winslow and Potter at 40 Wall st.

FRANK CHAMPION and Max B. Miller returned to the United States from Europe on the BREMEN, May 27.

H. JOHN EASTMAN, President, Eastman Oil Well Survey Company, left Los Angeles recently for Texas, where he was joined by Wm. G. James, Vice-President of the Eastman Oil Well Survey Company of Houston, Texas. Mr. Eastman and Mr. James will embark on the SS. BREMEN, from New York City for a six months' trip abroad. The two men will go to Roumania, Burmah, Germany, France, and England, and will demonstrate directional drilling in the Roumania and Burmah fields.

A. M. MAXWELL, vice-president of the Standard Oil Company of New Jersey, returned to the United States on the SS. WASHINGTON and landed in New York on May 2nd. Before joining the Ohio Standard some years ago, Mr. Maxwell was associated with the Ethyl Gasoline Corporation.

A. DIVOVITCH has been elected Chairman of the R.O.P. Ltd., London, in succession to Mr. Pevsner. Mr. Divovitch was born in Russia in 1899 and was appointed director of this Company 28th June, 1932, and at a Board Meeting held on 1st February, 1934, was made vice-chairman of the Company. He enters his new duties as chairman with a full knowledge of British marketing conditions and problems.

A. Divovitch

VENEZUELA

CARACAS, MAY 18, 1935

THE VENEZUELAN government has introduced in the Congress now in session a new Law of Hydrocarbons, which had its first reading on May 15th. Copies of the law are not yet available, but it is understood that the new or amended matter will not materially affect contracts or concessions already in force, but will relate particularly to free lands respecting which contracts may hereafter be made.

The present situation respecting petroleum areas in Venezuela is as follows: 1. Certain lands are held under definite contracts with the government, for whose exploitation both surface and production taxes have to be paid. 2. Other lands, originally held under such contracts, have been returned to the government by virtue of provisions of the contracts themselves, and are held by the government as "National Reserves." These areas, under the terms of an Executive Decree, are available for concessions under contract and are held at an upset or minimum price of fifteen bolivars per hectare, plus ordinary legal royalty charges. 3. The third class of available areas in Venezuela consists of free lands which may or may not have been the subject of previous contract, but which are disposable by the National Executive, through the Ministry of Industry (Fomento) to applicants who may desire to obtain and operate them under the existing law.

The present petroleum law makes provision for surface and production taxes with regard to lands of this class, but no charge is made by the government for the acreage which may be let under contract.

It is now understood that it is the intention of the Venezuelan government to amend the present Law of Hydrocarbons by the Bill recently presented to the Congress, so that lands of the third class above described, or such as may hereafter become vacant through caducity of existing contracts, may be treated similar to the "National Reserves." That is to say, that the Executive will be authorized to negotiate contracts for these lands which may stipulate an upset price per hectare and also production and surface taxes higher than those provided by the law of Hydrocarbons. It is further rumoured that the letting of lands at an upset price or at production and surface taxes greater than those provided by the law will be entirely optional, so far as the Executive is concerned.

Present reports indicate that the above will be the only change likely to be made in the existing Law of Hydrocarbons. If such be the case, present concessionaries can have no occasion for disquiet respecting change in the present law. In the event of amendment as above indicated, it would seem logical that a new Executive Regulation of the law should be forthcoming in the near future.

C. N. CLARK

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CANADA

IMPORTS of crude petroleum into Canada for the month of March amounted to 43,646,874 gallons valued at $1,309,973 which was a considerable decrease from March of 1934 when 70,609,617 gallons were imported at a value of $2,136,740. This March, 39,884,951 gallons were supplied from the United States, and 3,761,923 gallons from Venezuela.

IN THE annual report of the Texas-Canadian Oil Corporation, it is stated that during the fiscal year ended April 30, 1935, a total of 24 wells were drilled in the East Texas Oil Fields, "without a failure or a dry hole." This completes the 30 well programme inaugurated in that section. No financial statement accompanied this report.

This organization was originally known and organized as Wainwright West Oils Limited, to drill leases in Alberta's Wainwright Oil Field, but in 1931 the firm transferred its activities to the East Texas Oil Fields and last year the name was changed to the present one.

COLUMBIA Oils Limited, a firm developing a property on Saga and Kishinena Creek, British Columbia, has recently offered a second block of 100,000 shares at $1.00 per share. The first offer of 150,000 shares was completely subscribed. The second offer has been made to provide funds for carrying the well down to the producing horizon. It is now down to a depth of 3,140 ft.

Columbia Oils Limited was incorporated with a British Columbia charter in November of 1932. Certain of the shareholders have retained Dr. A. A. Olsson, petroleum geologist, to report on the fields. This at no expense to the company.

AN IMPORTANT change of ownership took place recently in the Turner Valley territory when Spooner Oils, one of the oldest independent Turner Valley organizations sold out most of its assets, including three small north valley producing wells, to the Royalite Oil Company, a subsidiary of Imperial Oil Limited.

With the completion of this transaction, Royalite Oil has acquired practically all the producing wells of the independent companies that were active during the Alberta oil boom of 1929–30. The Mercury and Miracle wells are the outstanding exceptions.

The transaction involved the transfer of the wells and limestone rights in exchange for 8,300 Royalite shares. Spooner Oils retains the small production secured from the Spooner No. 2 well from the Dalhousie sands and not the limestone.

Royalite No. 26, drilled about ten miles north of the present development in the south end of the field has developed into one of the largest wells in the Turner Valley district.

At the last report, its production was about 250 bbls. of naphtha daily and something like 20,000,000 cubic feet of gas under a back pressure of 1,000 pounds to the square inch. There is considerable hesitation as to predicting what it might produce if operating at its fullest extent. The Royalite Oil Company, however, is maintaining a policy of conservation and is holding production at the aforementioned level.

THE results achieved by Royalite have led to the announcement that the Model Oils will drill a well in section 22 as close as possible to the Royalite section.

Another new well has also been announced by Highwood-Sarcee, owners of the largest producing well in the Valley, located in the south end of the field. This will be drilled in the same section as the present producer.

The new Royalite absorption plant constructed in the south end of the field is expected to be ready to start operation about July 1st.

A small flow of wet gas as well as some crude is claimed for the Ranchmen's well outside Turner Valley where drilling is continuing. It is understood that 50 ft. of sand have been penetrated and the depth is around 6,320 ft.

ACCORDING to a statement made by President John Irwin at the annual meeting of the McColl-Frontenac Oil Co., Limited, gasoline sales in Canada increased three percent last year, with a proportionate increase in the sales of his own company.

R. C. ROWE

U. S. S. R.

Official Figures for Soviet Oil Operations

1935	Crude Production (bbl.)	Daily Average (bbl.)	Run to Stills (bbl.)	Drilling (feet)
January	13,358,100	430,935	11,400,000	248,672
February	12,704,300	453,725	10,909,500	334,000
March	14,139,300	456,107	11,714,000	449,417
April	14,058,200	468,609	11,350,000	431,050
Total 4 Months 1935	54,259,900	452,160	45,373,500	1,463,139
Total 4 Months 1934	54,569,000	454,742	47,195,900	1,351,927
Total 1934	168,648,700	458,042	145,141,000	4,122,898
Quota 1934	214,900,000	585,879	161,000,000	4,950,000
Quota 1935	232,400,000*	636,700	171,500,000	5,214,000

*Including gas; except gas 198,800,000 bbl. of crude.
Crude conversion: seven bbl. = one ton.

Developments of the Month

IT IS EVIDENT that no appreciable improvement has taken place in Soviet crude production during April as compared with previous months of last year, although drilling activity shows an increase of about 22 percent over the corresponding figure of last year. The total crude production for the first four months ending April, 1935 shows a decrease of slightly over one percent against last year in spite of the fact that production at Baku increased over three percent. Increased drilling activity is approaching full schedule with the spring season. This drilling, however, is measured by distance and speed is due largely to a small number of special wells which were taken under individual shock brigading care. These wells are mainly at Baku, Grozni and Maikop nearing completion and are expected to begin production in the near future. At any rate, the drilling records of these wells are fine examples of accomplishments.

Except these wells which have naturally contributed to the statistical data on distance and speed of drilling the routine operations are still proceeding slowly with the result that an insufficient number of new wells is coming in for production on specified dates in order to maintain production. However, the example of improved operations at individual wells is certain to be reflected in the tempo of general operation before long. At present Baku oil fields still supply about 80 percent of the total Soviet crude and are expected to balance the arrears incurred at Grozni and elsewhere. Baku operators are hunting for flush production and neglect entirely all wells with small quantities of production. The geological survey of Baku has recently reported that about 38 percent of all new wells to be drilled for production during 1935 are being sunk in unknown ground, i.e. without previous geological contouring or even approval. Production of the newly opened oil fields of Baku is increasing but the bulk of Baku production is still derived from the old oil fields.

U. S. S. R. Petroleum Exports by Products

	Jan. and Feb. 1935 (Figures in tons)	Jan. and Feb. 1934
Crude Oil	49	28,432
Gasoline	129,531	177,737
Kerosene	60,322	84,351
Lubeoil	29,399	24,511
Fuel oil	235,470	220,230
Diesel oil	9,100	11,685
Gas oil	73,467	86,019
Asphalt	2,466	3,428
Paraffin	2,290	1,261
Others	167	8
	542,261	639,662

Soviet oil exports in 1935 appear to be decreasing. This, however, is not necessarily the result of any shortages, but rather it is due to unfavorable world conditions, market prices and perhaps also in view of the trade barriers put up in recent years by governments in countries the geographical position of which tends most favorably toward Soviet oil. The former most favored trade clauses have at present become most favorable reciprocal trade and owing to this Soviet oil trade had to be dropped in Austria, Turkey and elsewhere, the reciprocal trade of which for the Soviets would have implied oranges, laces, etc.

Soviet Tankers

FROM a number of small shipping units such as the Northern, Black and Azov sea, Baltic and Caspian shipping agencies the Soviets created in 1923 the SOVTORGFLOT which is the abbreviation for Soviet State Mercantile Marine and has undertaken to reconstruct all shipping facilities which were available after the war. The number of seagoing vessels and their capacities was gradually increased by acquisition of old and new ships from abroad and several ships were built in Soviet shipping yards.

The capacity of the Soviet steam and motor driven fleet grew from 429,500 HP. in 1930 to 573,000 HP. in 1934 and the towed fleet rose from a carrying capacity of 4,297,000 tons in 1930 to 5,663,000 tons in 1934.

Position of the Soviet Mercantile Marine

	Units	Tons
1923	187	162,210
1925	175	211,000
1927	185	227,200
1929	182	269,850
1930	280	529,500
1934	no data	1,022,000

According to plans Soviet river shipments are to amount to 58,000,000 tons and Marine shipments 26,800,000 tons in 1935. The Second PIATILETKA calls for a considerable increase in Soviet water transport. In 1934 the increase over 1933 should have amounted to 25 percent, however, the plans were not fulfilled.

The Five Year Plan provided for the following shipbuilding program, in Soviet domestic yards.

Shipbuilding under 5-Year Plan

	Units	Tons Capacity
1929	18	31,000
1930	51	123,000
1931	109	375,000
1932	91	440,000
1933	73	316,000
1934	72	350,000

The percent participation of Soviet ships in Soviet foreign trade has increased gradually from 4.9 percent in 1921 to 8.3 in 1922 and subsequently to 9.1 percent in 1924, 7.8 percent in 1925, 7.0 in 1926. The average for 1927, 1928 and following years has amounted to about 8–9 percent.

About 60 aged or superannuated ships were at the disposal of the Black and Azov sea authorities in 1921. Considerable efforts were applied to salvage sunken and damaged craft and at the end of 1925 about 120 ships with a total capacity of 78,000 tons were plying both seas. Since 1924 Soviet sea trade grew year by year and in 1927 the Black Sea Mercantile Marine became a paying proposition.

In prewar Russia the river fleet played an important part in carrying of freight, in 1933 about 40 percent of all freight being carried by river transport. During the war the service became disorganized and the number of craft employed was considerably reduced. At the cessation of all hostilities only 63 percent of the vessels were serviceable while about 800 various steamers and 1,800 units of all kinds of other river craft were brought to a state beyond any repair.

The Soviet had entered upon reconstruction of the river fleet in 1919 when the total freight carried amounted to 7,600,000 tons. Already in 1923 almost 20,000,000 tons of freight were handled by the river fleet which subsequently increased to 40,000,000 tons in 1928. The plans for 1935 are 58,000,000 tons.

On January 1st 1926 the Soviets had at their disposal 1,109 river vessels with a total of 306,275 tons capacity and about 2,600 other craft for 2,750,000 tons carrying capacity.

Caspian Oil Fleet

BETWEEN 1920 and 1923 the Caspian oil fleet was detached from the Volga barge fleet and while both units were under different management orders for shipping or repairs emanated from various places such as Baku, Petrovsk Rakusha, etc., and there was no uniform-

Principal Soviet Ports

Baltic Sea:	Leningrad (Mouth Neva River)	Ice Breakers: "Lenin," "Sviatogor," "Ermak" "Krasin" Navigation April–October. Grain, Timber, Coal and Oil	
White Sea:	Kronstadt	Naval Base	
	Archangel	Ice free May–November	
	Murmansk	Open all year, nearest to Britain, Norway	
Black Sea:	Batum	Oil from Baku	20–28 ft. draft
	Novorossisk		20–28 ft.
	Tuapse	Oil from Grozni	20–28 ft.
	Odessa		(Oil Harbor 20 ft.)
	Poti		17–24 ft.
	Sevastopol	Naval base	27–35 ft.
	Theodossia		24–26 ft. (Unprotected against N. and N.W. winds)
	Nikolayev		26 ft.
	Kertch	Channel Port Black and Azov Seas	9–14 ft.
Azov Sea:	Taganrog		9–14 ft.
	Mariupol		24 ft. (Grain, Iron, etc.)
	Berdiansk		9–16 ft.
	Kherson		21–24 ft.
Pacific:	Vladivostok		23–30 ft.
	Rostov/Don		Mouth Don River
	Astrakhan		Mouth Wolga River—Caspian Sea

ity of operation. Early in 1923 the Soviets ordered a reorganization of the Caspian shipping under which the same has been united and coordinated with Volga shipping under management of GOSCASPAR or State Caspian Shipping. The fleet consisted at that time of 13 steamers and 28 barges in operation and 23 steamers and 43 barges under repair which represented 56 percent of the total steamers and 65 percent of the barges. On June 1st, 1923 the fleet consisted of 38 steamers for about 2,500 ind. HP. and 54 barges for a total carrying capacity of about 1,500,000 tons.

The Sea Tanker fleet of U.S.S.R. consisted of two tankers of about 12,000 tons in 1923. Russia now occupies 13th place in regard to tanker tonnage.

Registration of Tankers

	Ships	Tons
Gr. Britain	485	2,610,244
U. S. A.	411	2,525,331
Norway	190	1,325,407
Italy	78	346,471
Holland	78	284,438
Danzig	21	194,138
France	32	192,570
Germany	37	147,574
Sweden	18	143,840
Japan	23	120,017
Argentine	19	85,197
Denmark	14	84,906
U. S. S. R.	14	62,374
Belgium	9	59,860
Venezuela	21	52,388
Spain	9	35,404
Panama	3	24,824
Mexico	3	14,949
Rumania	3	14,737
Cuba	4	11,176
Greece	4	10,300
All others	15	25,815

Soviet shipyards are located at Leningrad, Nikolayeff, Odessa, Garki, Kroustadt and Kieff. Recently repair yards, etc., have been established on the Amur in the Far East.

Considerable expansion and enlargement has been accomplished since 1923 and oil tankers were added to the Caspian fleet. In 1934 several tankers were built for the Caspian oil trade by the Sormovo Shipyards, several units of which are of 6,000 to 8,000 tons carrying capacity.

Soviet Tanker Fleet

Owners	Vessel Afloat	Year Built	D. W. Tons
Goscaspar	Yalta	1916	800
	Andrei Shdanov	1934	7,600
	Stalin	1934	7,600
Sovtorgflot	Chaumian	1886	2,589
	Surakhan Neft	1914	7,900
	Azneft	1915	5,800
	Grozni	1916	6,225
	Alexander Emshanov	1922	1,940
	Apsheronneft	1924	5,420
	Maikop	1929	2,390
	Sovietskaya Neft	1929	11,090
	Stanislaw Kossior	1930	9,500
	Lokbatan	1930	2,390
	Batum	1931	8,150
	Skvortzov Stepanov	1931	4,000
	Sergo	1931	11,460
	Moskva	1931	9,800
	Nikolai Jansen	1932	11,460
	Varlam Aganessov	1932	9,850
	Azerbaidjan	1934	8,100
	Donbass	1934	10,100
	Sakhalin	1935	10,000
	Ural	1935	10,000
Total afloat 24			175,373
Under Construction			
	Josef Stalin		10,200
Total afloat and under construction 25			185,573

▼

Oil Futures

DURING the month of May, the gasoline futures market on the N. Y. Commodity Exchange declined almost to zero. Very few trades went across the board.

It became pretty well known in Wall Street and in oil circles late in May that changes were to be made in the contracts. Hence, oil men and speculators alike withdrew from the market to await the new contracts.

Criticisms and suggestions have come from all sources regarding the gasoline and crude oil contracts as they are how set up. WORLD PETROLEUM has learned from responsible sources that the Exchange is definitely considering them and that late in June new and improved contracts will be announced.

It is almost a certainty that two of the suggested changes recommended in this column in May WORLD PETROLEUM will be acted upon; namely, the elimination of the federal gasoline tax from the gasoline contract and the stepping up of the base grade from 55–59 octane range to the 60–64 range.

Other minor changes in both gasoline and crude oil are expected. Several suggestions emanating from marketing circles have asked for an increased number of delivery points but no change in the present set-up is anticipated now. WORLD PETROLEUM has also been able to learn that consideration of the establishment of a fuel oil contract is not contemplated at present.

There is also the possibility that West Texas crudes may be denied delivery on the crude oil contract.

The response of the petroleum industry to this new market has not been as good as was expected. Since the market opened on March 5, 1935 the crude oil market has been purely nominal and the gasoline market has only averaged about 7,000,000 gallons per month.

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British Imports

BRITISH petroleum imports during April, 1935 were 24.3 percent above the figure for April, 1934 bringing total imports for the first four months of 1935 above the figure for the corresponding period in 1934. The increase in imports during April was principally larger quantities of motor fuel from the West Indies, United States and Persia. A quantity of 235,000 bbl. crude imported in April in official British figures but for which the country of origin is not given is probably crude from Iraq.

British Oil Imports By-Products

(Barrels)

	April 1935	Four months to April 30 1935	Four months to April 30 1934
Lamp oil	485,372	2,097,517	2,441,657
Motor spirit	4,092,970	12,032,827	10,053,828
Lubricating oil	400,314	953,581	992,598
Gas oil	194,343	1,160,914	1,347,431
Fuel oil	1,651,487	5,653,487	5,444,199
Other sorts	40,000	202,988	232,773
Total products	6,864,486	22,101,314	20,512,486
Crude	1,157,600	4,278,542	4,482,200
Total imports	8,022,086	26,379,856	24,994,686

UNITED STATES

	Daily Crude Oil Production bbl.	Daily Runs to Stills bbl.	Total Motor Fuel Stocks bbl.	Imports for Week bbl.	California Shipments East for Week bbl.
Week ending April 27	2,564,500 458,500*	2,580,000	65,690,000	994,000**	None
Week ending May 4	2,509,500 467,000*	2,415,000	63,899,000	1,065,000**	117,000
Week ending May 11	2,644,500 468,000*	2,520,000	64,880,000	966,000**	176,000
Week ending May 17	2,650,000 468,200	2,530,000	64,990,000	1,007,000	518,000

Underlined figures indicate improvement in statistical position—decrease in production, runs to stills, gasoline stocks and imports.

*Estimated total production of the Rusk-Gregg field, East Texas, official and unreported.

**Import figures include all oil imported, for domestic use and in Bond for re-export, it being impossible to make the separation in weekly statistics.

Federal Legislation

WITH public opinion in the United States swinging very definitely against federal interference with private business enterprises, the three major federal legislative measures affecting the oil industry were being altered and softened to the point of becoming only shadows of original bills, while the fourth measure, the Wagner labor bill, was passed by the Senate in unaltered form.

The Thomas oil control bill, which provides for federal allocation of production between the states and for federal enforcement of such allocations if not complied with, is not thought to have enough strength to be passed even by the Senate.

The Wheeler-Rayburn utility holding company bill, reported in the preceding issue of WORLD PETROLEUM, was still being re-written in the Committee of the House of Representatives.

The Wagner Labor Disputes Bill, the most drastic labor measure ever passed by a house of Congress, passed the Senate by an overwhelming vote of 68 to 12 on May 16. Under the Wagner bill there would be created a Permanent Labor Relations Board of three with authority to supervise employe elections and to establish collective bargaining between employers and employes. The bill provides for the "majority rule" for employe bargaining and representation, a feature which is opposed by almost all large and small employers of labor as suppressing minority groups, which are only permitted to present "grievances". The bill provides for abolition of company unions, prohibiting employers from contributing financial or any other support to labor organizations.

Texas Tightens Enforcement

THE Texas Railroad Commission and the attorney general, W. McCraw, were fully backed by the Texas legislature which empowered the state to confiscate all illegally produced crude oil and to increase from 1/8th to 3/16th of a cent per barrel the tax on crude diverted to support the Texas Railroad Commission, which plans immediately to increase its staff to be able to handle the oil enforcement effectively. Both measures were approved by majorities sufficient to make the new laws effective immediately upon the signature of Governor Allred, which was affixed to both bills on May 13. The law providing for confiscation of illegally produced crude oil is expected to relieve the storage problem in the East Texas field, such oil to be disposed of at state sales. In the meanwhile, more effective enforcement under old laws reduced the "hot" oil production in the East Texas field to not over 25,000 bbl. per day, and new regulations are expected further to cut this overproduction to not over 15,000 bbl. per day.

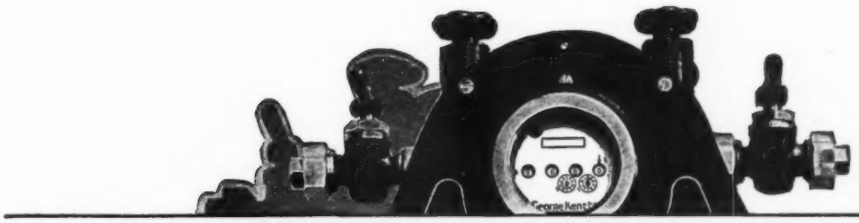
Prices Continue to Improve

THE effective curtailment of the East Texas "hot" oil production to around 20,000 bbl. per day, together with the adoption of new enforcement measures by the State of Texas, served to strengthen materially the price structure of all petroleum products. During the past month refinery gasoline quotations were very steady, advancing from 1/8th to 1/4 cents per gallon in the Mid-Continent, while the retail motor fuel markets were uniformly higher throughout the United States. Natural gasolines and kerosenes participated in the upward movement, while crude oil continued very firm.

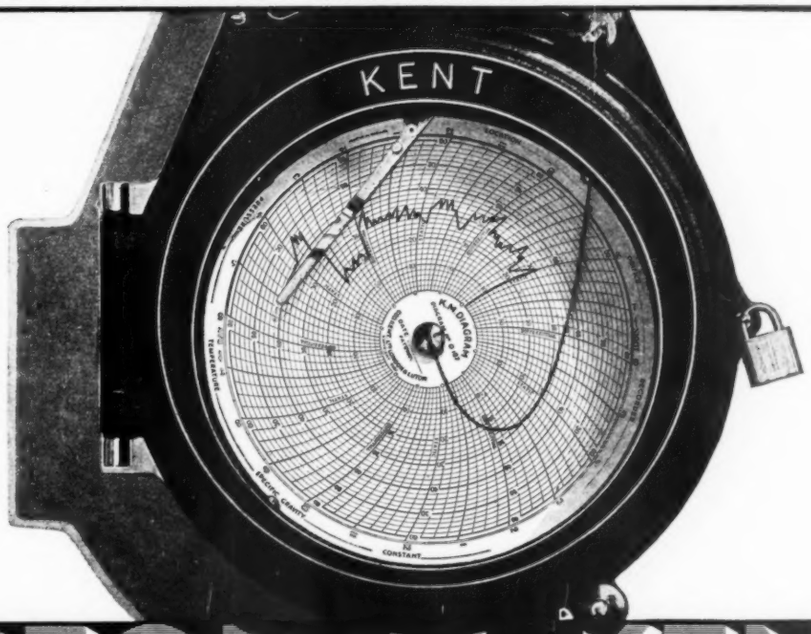
Crude oil prices during the last 30 days remained very strong and unchanged at $1.00 per barrel for 36 gravity Mid-Continent grade, and $1.00 flat per barrel for the East Texas crude. Premiums of around 10 cents per barrel appeared locally in the Mid-Continent area, and a 15 to 25-cent advance in all grades of Mid-Continent appeared scheduled for the near future. Pennsylvania grades of crude oil were cut 10 to 15 cents per barrel on May 15

Gulf Export Prices for Major Oil Products

	Product	Cents per Gallon			
		April 22	April 30	May 7	May 14
Gasoline:	U. S. Motor	4⅝	4⅝	4¾	4⅝
	64/66-375 E. P.	5	5	5	4⅞
	59 Oct. & below	5	5	5	5
	65 Oct. & above	5¼	5¼	5¼	5¼
Aviation Gasoline:	73 Oct. & above	9	9	9	9
Kerosene:	44 w.w.	4¼	4¼	4¼	4¼
	41-43 w.w.	4	4	4	4
	41-43 p.w.	3⅞	3⅞	3⅞	3⅞
Gasoil:	26-30 translusc.	2⅞	2⅞	2⅞	2⅞
	30 plus translusc.	3⅛	3⅛	3⅛	3⅛
Fuel Oil:	Bunker purposes (per bbl.)	$1.00	$1.00	$1.00	$1.00
Grade C:	Cargo lots (per bbl.)	$ .82½	$ .81½	$ .83	$ .80
	Diesel oil (per bbl.)	$1.70	$1.70	$1.70	$1.70
Lubricating Oil:	Bright Stock No. 8	21	21	21	22
(New York Export	Bright Stock No. 6½	21½	21½	21½	21½
Market)	Warren E.	18½	18½	18½	19
	600 Unfilt.	14½	14½	14½	15
	650 Unfilt.	16	16	16	16
	600 Flash s.e.	16½	16½	16½	16½
	630 Flash s.r.	21	21	21	21
	Neutral 200 No. 3	28½	28½	28½	28½
	Neutral 150 No. 3½	23½	23½	23½	23½
So. Texas:	300 No. 3 pale	6¾	6¾	6¾	6¾
	500 3½ pale	7⅞	7⅞	7⅞	7⅞
	750 4 pale	9	9	9	9
	1200 4 pale	9½	9½	9½	9½
	500 No. 5-6 red	7⅞	7⅞	7⅞	7⅞
	750 5-6 red	9	9	9	9
	1200 5-6 red	9½	9½	9½	9½
Crude Oil:	East Texas crude delivered at Gulf port for Export	$1.16	$1.17	$1.17	$1.17



FOR ACCURATE MEASUREMENT OF ALL FLOWS



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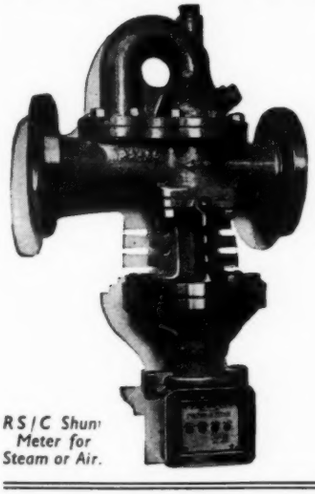

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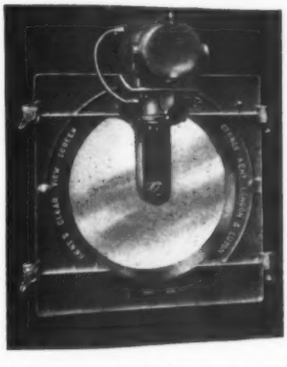

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U. S. production, runs to stills and price of crude oil in relation to stocks of all petroleum products.

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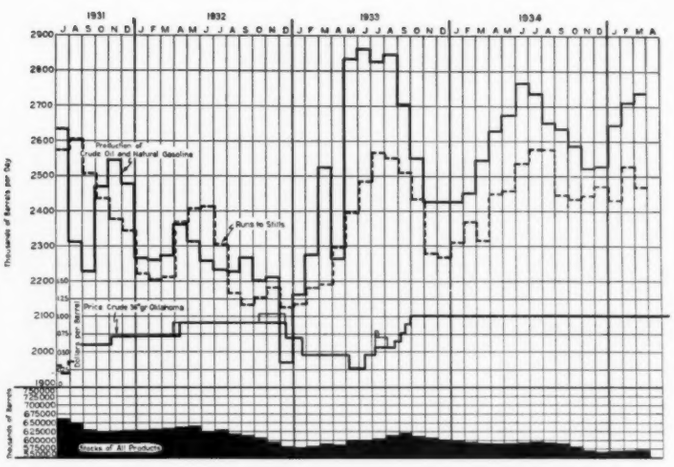
1931
1932
1933
1934
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A
Thousands of Barrels per Day
Production of Crude Oil and Natural Gasoline
Runs to Stills
Price Crude 36° gr. Oklahoma
Dollars per Barrel
Thousands of Barrels
Stocks of All Products

to $2.20 a barrel in Bradford field and to $1.87 in Eureka Pipe Line Co. lines. Present reduction in Pennsylvania crude oils has been anticipated for some time, and further equalization with Mid-Continent grades is considered probable as the improved refinery practices produce excellent lubricating oils from Texas and Oklahoma crudes.

Tank wagon/service station motor fuel prices per gallon, regular grade, including all taxes, in representative districts in the middle of May were: 14.55/18.3 cents in metropolitan New York (13.3/16.8 cents in Newark, N. J.); 13.0/16.5 cents in Boston, Mass.; 12.0/15.5 cents in Providence, R. I.; 15.2/17.2 cents in Chicago; 16.5/18.5 cents in Ohio; 16.5/18.5 and 16.0/18.0 cents in San Francisco and Los Angeles respectively; 16.0/18.0 cents in Oklahoma; 15.0/17.0 cents in Dallas and Fort Worth, and 15.0/17.0 cents in Houston, Texas; 14.9/16.9 cents in St. Louis and East St. Louis; and 24.0/27.0 cents in Montreal, Canada; all with a 2-cent differential for premium grade.

Refinery gasoline quotations in the Mid-Continent district advanced from ⅛th to ¼ of a cent per gallon during the past month, and further improvement is anticipated. Refinery gasoline was quoted on May 20 at 4⅜–4⅞ cents per gallon for 58–60 U.S.M. grade 62.9 and below octane rating in Group 3, Oklahoma market; 63.0–70.9 octane rating, U.S.M. "regular" grade, was quoted at 5⅜–5⅝ cents per gallon; and 71.0 and above octane rating, U.S.M. "premium" grade brought 5½–5¾ cents per gallon. The East Texas markets were as strong, lagging about ⅛ of a cent behind Group 3 quotations. On the East Coast, at Bayonne, U.S.M. grade 60.0–64.9 octane rating gasoline was quoted at 5¾ cents per gallon (3.40 cents gold*). Gulf Coast prices for export on May 20 were unchanged at 4½–4⅝ cents per gallon (2.71 cents gold*) for grade 58–60 U.S.M.

Natural gasolines advanced further under the influence of the general market strength, and on May 20 grade 26–70 was quoted at 3⅛ cents per gallon (1.85 cents gold*) in Oklahoma; at 3 cents per gallon (1.77 cents gold*) in North Texas; and 3¼ cents per gallon (1.92 cents gold*) in North Louisiana.

Kerosene prices advanced around ½ of a cent per gallon during the past month in the Mid-Continent markets under the impetus of increased agricultural demand, but continued weak on the East Coast. On May 20 grade 41–43 w.w. was quoted at 4–4⅛ cents per gallon in Group 3, Oklahoma market, and at 5–5¼ cents per gallon (3.10 cents gold*) on the East Coast at Bayonne. Gulf Coast prices for export remained unchanged at 3⅞–4 cents per gallon (2.29 cents gold*) for 41–43 p.w. grade and at 4–4¼ cents per gallon (2.43 cents gold*) for 41–43 w.w. grade.

The anticipated increase in crude oil prices during the coming summer should be immediately reflected in higher quotations for refinery products, while the reduced volume of "hot" oil in the East Texas field, cutting off the supplies from the under-cutting service stations, should cause uniformly higher retail quotations.

Export Shipments Increase

DURING March, 1935, total gross imports of all petroleum products into the United States amounted to 4,415,000 bbl., 142,600 bbl. per day, as compared with 3,689,000 bbl., 131,800 bbl. per day, imported during the preceding month; out of this total during March, 1935, 2,725,000 bbl., 87,800 bbl. per day, were imported for domestic use and 1,690,000 bbl., 54,500 bbl. per day, were imported in transit either for refining and re-export or for use in vessels in foreign trade. During the preceding month, February of 1935, 2,104,000 bbl., 75,000 bbl. per day, were imported for domestic use and 1,585,000 bbl., 56,800 bbl. per day, were imported in bond as indicated above. The crude oil imported for refining and re-export amounted in March, 1935, to 720,000 bbl. Accordingly during March the net imports for domestic use continued well within the federal allowable of 108,400 bbl. per day. The proposal advocated by the Independent Petroleum Association of America for "repealing the law exempting imports used as supplies for vessels from excise taxes" should not be adopted inasmuch as if this law is repealed vessels in foreign commerce will bunker in foreign ports for

*U. S. Dollar at 41 percent discount.

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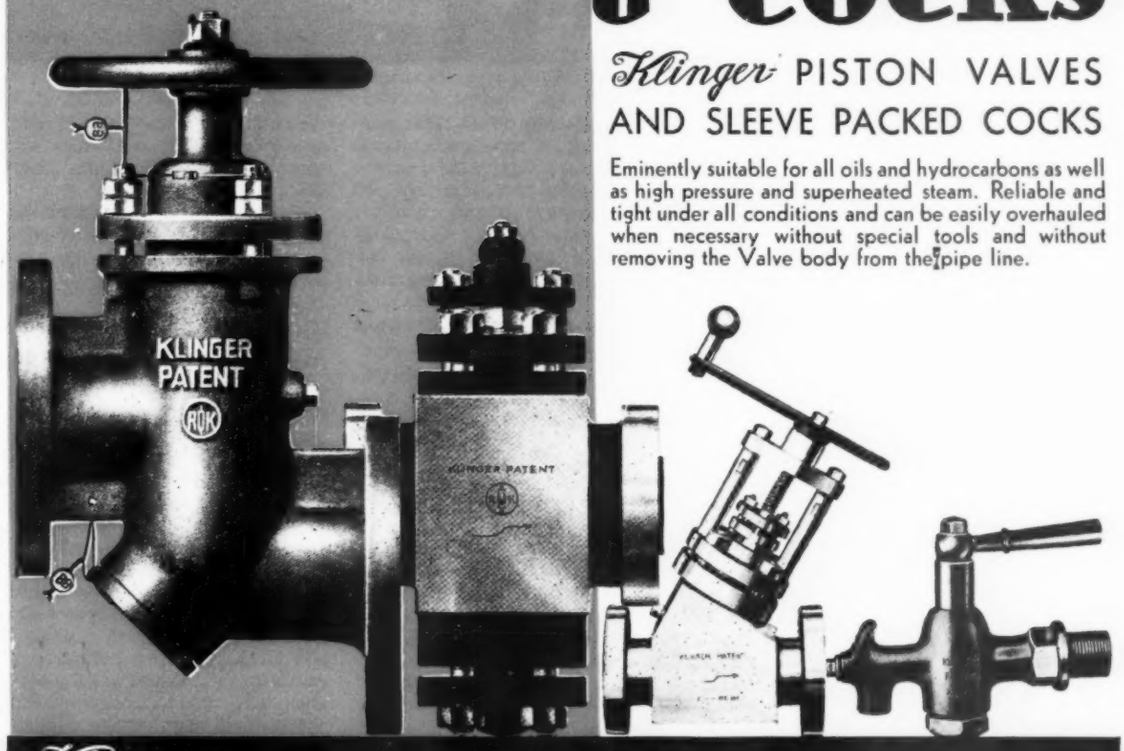

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U. S. consumption and exports, production, imports and prices of motor fuel in relation to motor fuel stocks.

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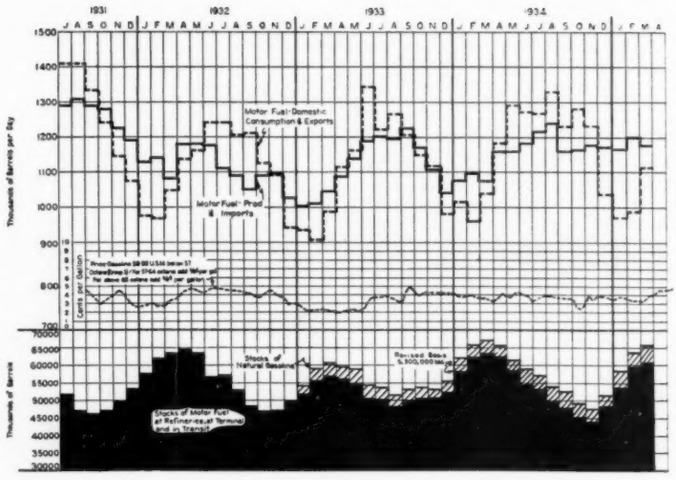

1931
1932
1933
1934
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A
Thousands of Barrels per Day
Motor Fuel Domestic Consumption & Exports
Motor Fuel Prod. & Imports
Cents per Gallon
Thousands of Barrels
Stocks of Natural Gasoline
Stocks of Motor Fuel at Refineries, at Terminals, and in Transit

round trips, as was the case prior to the enactment of this amendment. In the last several months the balance of foreign trade in petroleum and its products has been so impressively in favor of the United States, both quantitatively and qualitatively, that any changes in tariff that may, directly or indirectly, by retaliation, affect this balance should not be experimented with.

Exports of all petroleum products during March, 1935, increased 50 percent as compared with the preceding month, reaching 9,845,000 bbl., 317,000 bbl. per day, as compared with 6,560,000 bbl., 234,500 bbl. per day, shipped during February, 1935. The March, 1935, exports were almost unchanged from the export volume in March of 1934 when 9,353,000 bbl., 302,000 bbl. per day, were shipped. Exports of crude oil from the United States during March, 1935, continued to be small, amounting to 3,281,000 bbl., 106,000 bbl. per day, as compared with 2,804,000 bbl., 100,000 bbl. per day, exported in the preceding month, and a daily average of crude oil exports of 112,800 bbl. during the whole of 1934. In March of 1935 crude oil exports constituted 33.35 percent of the total exports of all petroleum products.

Production Effectively Controlled

CRUDE oil and natural gasoline production during April, 1935, averaged about 2,710,000 bbl. per day, almost unchanged from the preceding month when 2,738,000 bbl. per day were produced; and was about 168,000 bbl. per day above the crude oil and natural gasoline production in April of 1934, an increase of 6.60 percent. The April, 1935, average daily crude oil production exceeded the federal allowable by 50,000 bbl. per day. During April, 1935, Texas overproduced 855,000 bbl.; Oklahoma overproduced 520,000 bbl., and Kansas overproduced 130,000 bbl.; while California underproduced 480,000 bbl. The figures for the first half of May suggest that crude oil production in that month may come within 20,000 bbl. of the federal allowable.

The crude oil runs to stills during April, 1935, averaged about 2,545,000 bbl. per day, or 73,000 bbl. per day above the runs to stills during the preceding month when 2,472,000 bbl. per day were refined.

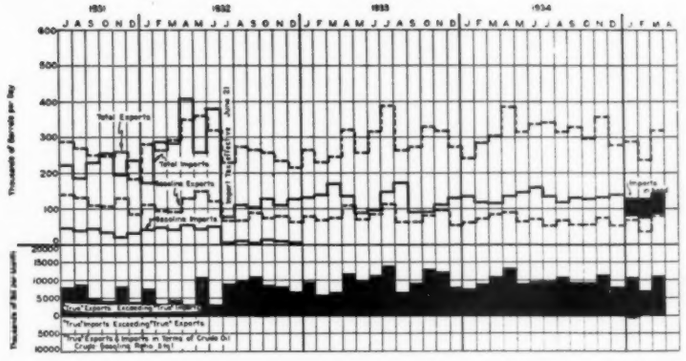
Total stocks of all petroleum products increased during March, 1935, by 2,528,000 bbl.; to a total of 570,829,000 bbl., indicating a daily gross seasonal addition to stocks of 84,200 bbl.

Motor Fuel Demand High

INDICATED domestic demand for motor fuel during March, 1935, averaged 1,032,000 bbl. per day, an increase of 9.33 percent above the daily average during February, 1935, when 944,000 bbl. (corrected) were consumed per day; the domestic demand during March, 1935, was 34,600 bbl. per day above the domestic motor fuel consumption in March of 1934, an increase of 3.47 percent; 116,900 bbl. per day above the domestic motor fuel consumption in March of 1933, a continued very marked increase of 12.76 percent; and 34,100 bbl. per day above the domestic motor fuel consumption in March of 1931, the peak year before 1934, an increase of 3.44 percent.

The NEW YORK TIMES weekly combined business index declined about 6 points during the past month but recovered slightly early in May, standing at 83.0 in the week ending May 4, 1935, as compared with 85.6 in the week ending April 13, 1935. The index stood at 85 on May 1, 1934; at 68 on May 1, 1933; and at 65 on May 1, 1932. The decline in business activity during April, 1935, is somewhat unsettling, paralleling closely the set-back of July, 1934, thus tending to suggest that under current form of federal guardianship private business cannot prosper. Favorable factors at this time are: (1) for long term outlook—public opinion fighting effectively against federal control of business; and (2) for the immediate future—the spending of $4,800,000,000 for public works by the federal government, of which $1,000,000,000 has been appropriated during May.

The daily rate of exports of motor fuel averaged 84,000 bbl. in March, 1935, 86.6 percent above the preceding month; 2.56 percent



Total U. S. imports and exports and gasoline imports and exports in relation to true exports exceeding true imports.

above the motor fuel exports in March of 1934; 9.80 percent above the exports in March of 1933; but 11.58 percent under the motor fuel exports in March of 1931.

On April 1, 1935, motor fuel stocks at refineries, plants, terminals or in transit amounted to 65,557,000 bbl., a seasonal increase of 1,937,000 bbl. as compared with stocks on hand on March 1, 1935, indicating that during March motor fuel supply exceeded demand by 62,400 bbl. per day.

Field Developments—Texas

On the Gulf Coast in Chambers County, 50 miles due east from Houston and in the new Anahuac field, the Humble Oil and Refining Company (S.O.N.J.) completed during the past month two new producers, west and south offsets to the discovery producer reported in the May issue of World Petroleum. Humble Oil and Refining Company's No. 1 J. J. Clark, the west offset, was brought in for 745 bbl. per day initially through ¼-inch choke from the Frio sand topped at 7,034 ft. and drilled to 7,117 ft.; No. 1 J. J. Clark is reported as being 29 ft. structurally lower than the discovery well. Same company's No. 1 Broussard in Section 63, H. & T. C. Survey, the south offset, was completed for 695 bbl. per day initially through ¼-inch choke with a total depth of 7,125 ft. The new completions, while not extending the Anahuac field appreciably, indicate uniform and dependable sand conditions and are accordingly of considerable importance.

A regionally important discovery was made at the end of April by the Union Sulphur Company in Hidalgo County, 8 miles north from Mercedes and near the Rio Grande. That company's No. 3 American—Rio Grande Land and Irrigation Company, in Lot 2,082, Section 86, tested 10 bbl. per hour from the Frio sand topped at 7,477 ft. and drilled to 7,493 ft., thus opening for the southernmost counties of Texas possibilities of deep prolific production. The Union Sulphur Company holds about 35,000 acres in the vicinity of the discovery well in a solid block, which was surveyed by reflection seismograph work by the McCollum Exploration Company.

Gulf Production Company's No. 103 J. T. McElroy in Crane County, the deepest well ever drilled in the world, is at this writing drilling at 12,720 ft. in limestone, about 1,370 ft. in the Ordovician section without any oil, gas, or water showings.

Oklahoma

The Fitts pool, in Pontotoc County, continued to gain rapidly in activity and by the middle of May it had 105 completed Simpson sand wells with a total daily potential of 365,000 bbl., while the expected completions are scheduled to bring the total number of completions to 120 and the daily potential to around 420,000 bbl. by June 1. A very important ½ mile extension due west was made by Delaney and others in their No. 1 Smith in Section 26-T2N-R6E which was rated for 9,984 bbl. of crude oil and 6,000,000 cu. ft. of gas per day from Simpson Bromide sands at 4,215–4,235 ft. and 4,283–4,338 ft. This extension suggests that the area affected by salt water in the south half of Section 25-T2N-R6E is very localized and probably is due to complicated faulting; the extension also proves for prolific production all of the Phillips Petroleum Company's 160-acre tract in the Southwest Quarter of Section 25, which the company recently acquired. With a 3.5 percent allowable the Fitts pool is currently producing around 14,000 bbl. per day. A most

Effect of Federal Proration Orders in Principal Oil Producing States

	Sept. 1933 to April 1935 Cumulative Overproduction		April, 1935 Over-production	May 1935 Federal Daily Quota	Daily Average Production for Week Ending	
	bbl.	% of Total	bbl.	bbl.	May 4 bbl.	May 11 bbl.
Texas	37,038,000	56.1	855,000	1,032,900	1,046,000	1,054,500
Oklahoma	10,024,500	15.2	520,000	500,200	458,500	523,000
California	7,923,000	12.0	*	494,200	452,500	516,000
Kansas	2,639,000	4.0	130,000	148,400	144,500	146,000
United States	65,959,000	100.0	1,550,000	2,561,200	2,509,500	2,644,500

* California underproduced 480,000 bbl. during April.

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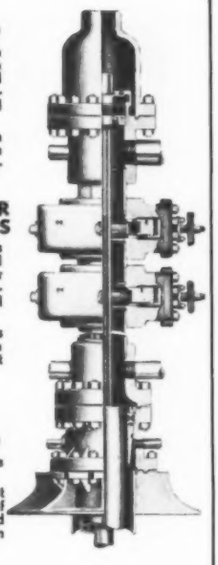

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important wildcat test is starting about 14 miles due east from the Fitts pool on the Centrahoma structure, which was originally mapped on the surface and was subsequently tested with seismograph. The Centrahoma test will be drilled by the Carter Oil Company (S.O.N.J.), the Ramsey Petroleum Company, the Stanolind Oil and Gas Company and the Mabee Consolidated. The importance of the Centrahoma test is due to the fact that it is considered to be the best looking prospect in southeastern Oklahoma, and its failure or success will greatly influence all future work in that area.

The new potential tests in Oklahoma City field on 477 "Wilcox" sand wells show a new potential of 391,758 bbl. per day as compared with November, 1934, potential of 859,009 bbl. per day, a decline of 54.4 percent, these data being figured on the basis of first 4-hour flow multiplied by 6. The new basis of calculation provides for the last 4 hours of 6-hour flow to be multiplied by 6 to obtain the potential and on that basis the new potential is 603,737 bbl. per day, a decline of 29.7 percent below the November, 1934, potential flow. About 30 wells are currently drilling or rigging up in the recently opened for drilling residential district of Oklahoma City on the north end of the field. Completions of these tests will be of great importance in helping to study subsurface drainage, since leases immediately due south from the newly developing area have recovered very large volumes of crude oil, presumably derived in part from the undrilled sectors due north.

The Polo field in Noble County was extended during May ½ mile due north by the Atlantic Oil Producing Company's No. 1 Porter in Section 22-T22N-R2W, which was completed at 4,935 ft. for 2,400 bbl. per day from Simpson formation. There are at this writing 24 completed oil wells in the Polo field, while 5 are drilling.

The Lucien field, also in Noble County, was extended late in April one mile due southeast by Stanolind Oil & Gas and Amerada Oil Companies' No. 1 Fuller, in section 34-T2ON-R2W, which was originally completed for 236 bbl. per day from 5,100 ft. in the upper Simpson section, but after acidizing increased to around 5,000 bbl. per day. The new extension suggests at this time the possibility of a second closed structure and field due southeast from Lucien proper, but only actual drilling will determine whether such is the case.

Wyoming

THE OHIO OIL COMPANY and the California Company's (The Texaco) No. 1 Kyle in Section 26-T31N-R79W in Carbon County and on the Big Medicine Bow dome, apparently opened an important field when it tested 165 bbl. of 63 gravity crude oil per hour on drill stem test in the Sundance sand from 5,299 to 5,361 ft. The discoverers of the field control around 7,000 acres around the well.

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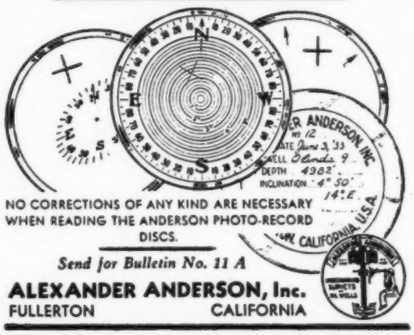

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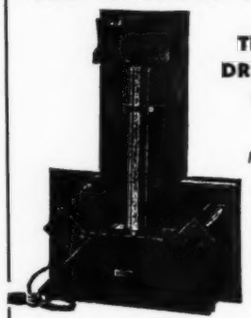

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